

Essi Ahokas

**MEASURING THE OFFERING DEVELOPMENT
PROCESS PERFORMANCE**
Case Study

ABSTRACT

Essi Ahokas: Measuring the offering development process performance
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Performance measurement has gained attention since 1990's. Organizations have implemented different management trends and philosophies since, and furthermore, new trends are still evolving. Organizations have better capability for measuring performance, as nowadays IT architecture enables organizations to produce and capture more data. In this thesis the performance measurement in research and development (R&D) process is examined.

The objective of the thesis is to study how the performance of the offering development process can be measured in the case company. In the management accounting literature, performance measurement has been examined through the entire organization's performance. The need for study of innovations, such as process management, has been emphasized in the literature. The objective of this thesis is to fill that gap in the research field. The thesis is conducted by analyzing the current performance measures in the new product development (NPD) process from the perspective of management accounting and process management.

In the theoretical framework of the thesis, the topics about the nature of the R&D function, quality and process management, management controls systems, measuring performance in general and measuring business process performance are discussed. The similarities in developing measures in management accounting, and process management were found. The research data was gathered by unstructured interviews. In addition, the documents from case company were used as research data. The interviews and documents were analyzed by using data driven content analysis.

In the current offering development process, the new product development (NPD) was seen to be important stage of the process. The context is the key factor for developing measures. Current views about the process performance supported the findings from the analysis of current NPD measures. The forecasted cash flow and costs for products estimated better performance for products than what was achieved. The measurement challenges were found regarding the material costs, work-related costs and options. In addition, the process consistency and development of information systems were seen crucial for process performance.

In the conclusion of the thesis the measurement challenges and recommended solutions for improving the measures are introduced. The case company can utilize the findings in the development of current and future measures. Furthermore, the findings can be utilized in other core process measures. The results of this case study cannot be generalized and transferred, as the phenomenon of performance measurement cannot be separated from the organizational context. However, the thesis can be utilized for practical advices about the performance measures in organizations which are implementing the process management thinking.

Keywords: Performance measurement, process measures, management accounting, process management, R&D

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TIIVISTELMÄ

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Suoritusmittausta on käsitelty kirjallisuudessa 1990-luvulta alkaen. Organisaatiot ovat implementoineet erilaisia johtamisfilosofioita siitä lähtien, ja uusia trendejä syntyy yhä. Organisaatioilla on lisääntyvä kyky suorituksen mittaamiseen, sillä tietotekninen kehitys mahdollistaa datan entistä paremman tuottamisen ja hyödyntämisen. Tässä tutkielmassa tarkastellaan tuotekehityksen prosessin suoritusmittausta.

Tämän tutkielman tavoitteena on tutkia, kuinka tuotekehityksen prosessin suoritusta voidaan mitata tapaustutkimuksen keinoin case-yrityksessä. Johdon laskentatoimen tutkimuskirjallisuudessa pääosin koko organisaation suoritusta on tutkittu. Kirjallisuudessa on painotettu uusien innovaatioiden, kuten prosessijohtamisen, tutkimista johdon laskentatoimen näkökulmasta. Tämän tutkielma pyrkii täyttämään tätä tutkimusaukkoa analysoimalla nykyisiä tuotekehityksen mittareita johdon laskentatoimen ja prosessijohtamisen näkökulmasta.

Tutkielman teoreettisessa viitekehityksessä tarkastellaan tuotekehitys-funktion luonnetta, laatu- ja prosessijohtamista, johdon kontrollijärjestelmiä, yleisesti organisaation suoritusmittausta sekä prosessin suoriutumisen mittarointia. Suoritusmittariston kehityksessä havaittiin yhtäläisyyksiä johdon laskentatoimen ja prosessijohtamisen kirjallisuudessa. Tutkimusaineisto kerättiin avoimilla haastatteluilta sekä case-organisaation dokumentteja käytettiin tutkimusaineistona. Haastattelut ja dokumentit analysoitiin aineistolähtöisen sisällönanalyysin keinoin.

Tärkeänä vaiheena nykyisessä tuotetarjonnan prosessissa nähtiin uuden tuotteen kehityksen prosessi. Organisaatioympäristö on avainasemassa suoritusmittariston kehityksen kannalta. Haastatteluissa esiin nousseet nykyiset näkemykset prosessin suoriutumisesta tukivat löydöksiä tuotekehityksen mittareiden analyysistä. Ennustetut kassavirrat ja kustannukset tuotteille arvioitiin paremmiksi kuin tuotteiden todellinen suoritus osoitti. Suoritusmittaroinnin haasteet liittyivät materiaalikustannuksiin, tuotteelle tehtävään työhön liittyviin kustannuksiin sekä tuotteisiin valittaviin optioihin. Lisäksi prosessin yhdenmukaisuus ja tietojärjestelmien kehitys nähtiin tärkeinä prosessin suorituksen kannalta.

Tutkielman yhteenvedossa esitellään mittaroinnin haasteet ja ratkaisuehdotukset mittaroinnin parantamiseksi. Case-yritys voi hyödyntää tutkielman tuloksia kehittäessään nykyisiä ja tulevia suoritusmittareita prosesseille. Lisäksi yritys voi hyödyntää tuloksia muiden pääprosessien mittareiden kehityksessä. Tämän tutkielman tuloksia ei voi yleistää, sillä suoritusmittaristoa ei voida erottaa organisaatioympäristöstä. Yritykset, jotka vasta implementoivat prosessijohtamisen mallia, voivat hyödyntää tutkielman tuloksia käytännön neuvoina.

Avainsanat: Suoritusmittaus, prosessimittarit, johdon laskentatoimi, prosessijohtaminen, tuotekehitys

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CONTENTS

1 INTRODUCTION	1
1.1 PURPOSE OF THE THESIS	3
1.2 RESEARCH STRATEGY.....	4
1.3 OUTLINE OF THE THESIS	6
2 THEORETICAL FRAMEWORK	8
2.1 MANAGEMENT ACCOUNTING AND R&D	8
2.2 QUALITY AND PROCESS MANAGEMENT	9
2.2.1 The history and evolution of business process management.....	9
2.2.2 Quality management	11
2.3 MANAGEMENT CONTROL SYSTEMS	12
2.4 MEASURING PERFORMANCE	19
2.4.1 The framework of balanced scorecard (BSC)	22
2.4.2 Management accounting and quality.....	24
2.4.3 Measurement issues.....	26
2.5 PERFORMANCE MEASUREMENT OF BUSINESS PROCESSES	29
2.6 SUMMARY OF THE THEORETICAL FRAMEWORK	35
3 INTRODUCTION TO EMPIRICAL PART	39
3.1 EXECUTION OF THE EMPIRICAL PART	39
3.1.1 Gather and analysis of data.....	39
3.1.2 Reliability of the thesis.....	43
3.2 INTRODUCTION TO THE RESEARCH DATA	44
4 EMPIRICAL RESULTS	47
4.1 THE CONTEXT OF OFFERING DEVELOPMENT PROCESS	47
4.2 MEASURES OF NEW PRODUCT DEVELOPMENT	49
4.3 MEASUREMENT CHALLENGES IN OFFERING DEVELOPMENT PROCESS	62
4.3.1 Material costs	63
4.3.2 Work-related costs.....	64
4.3.3 Options	68
5 DISCUSSION AND CONCLUSIONS	70
REFERENCES	81
APPENDIX	84
APPENDIX 1: INTERVIEW GUIDE.....	84

THE LIST OF TABLES

Table 1 The context of offering development in case division X	47
Table 2 Current NPD measures.....	50
Table 3 Cash flow calculation for product Y	54
Table 4 Cash flow calculation for product Z.....	55
Table 5 Cash flow calculation for product X	56
Table 6 Consolidated cash flow calculation for products Y, Z and X.....	57
Table 7 Measurement challenges in offering development process	62
Table 8 Consolidated work costs for product Y, Z and X	65

THE LIST OF FIGURES

Figure 1 The manufacturing cost bridge for product Y	59
Figure 2 The manufacturing cost bridge for product Z.....	60
Figure 3 The manufacturing cost bridge for product X.....	61

1 INTRODUCTION

Business process management (BPM) is not new idea in the field of management philosophies (De Toro & McCabe 1997). According to Jeston (2018, 11) in 1980's the focus was on quality thinking. Different frameworks in the field were Total Quality Management (TQM), Six Sigma, ISO and concept of Kaizen. The process thinking was already discussed in the early 1900's. In 1990's the process thinking was supported by Business Process Re-engineering (BPR) and followed by Lean thinking. In the late 1990's and early 2000's enterprise planning systems (ERP) were developed and brought the automation to companies. They were marketed as solving all organizations' problems. At the same time customer relationship management (CRM) was developed focusing on customer view. However, CRM did not support improvements in backline processes. Furthermore, the business process management was developed more by automation and for example, the concept of workflow. According to Jeston (2018, 12), also cloud service is crucial for process thinking as it supports integrated documentation for improve process thinking in different locations around the globe. The term business process management is not important, instead the idea behind it. It's important that organizations manage business processes and involve people in the organization. (Jeston 2018, 12.)

Endrikat, Guenther and Titus (2020) state that the traditional financial measures did not meet the demands of modern management in 1990's. Different market demands and management philosophies emphasize the performance measurement in the 1990's. Combining both traditional financial and operational non-financial measures was new innovation for managing business. According to Hoque (2014), many different performance measurement frameworks were developed and published in the 1990's. The idea of "what you measure, is what you get" got more attention. Hoque (2014) argues that the most popular framework is balanced scorecard (BSC) developed by Kaplan and Norton originally in 1992. Kaplan and Norton (1996) divide performance into four dimensions, which are financial perspective, customer perspective, internal business process perspective and learning and growth perspective.

Management accounting and management accounting systems are used for developing measures. Especially performance measurement is studied in the field of strategic management accounting. According to Rashid and Hossain (2020), strategic management accounting (SMA) techniques are different from traditional management accounting techniques as SMA tools focus on external context of the organization, have long-term or future-oriented time range and focus both on financial and non-financial information. In the field of performance measurement, Neely (2005) states that the balanced scorecard is the most researched topic based on citations. Furthermore, Langfield-Smith (2007, 64) states that BSC is the most studied topic in the field of management accounting. After 15 years, the balanced scorecard remains the most studied framework in the field of strategic management accounting (Rashid & Hossain 2020).

In this thesis, the emphasis is on the offering development process. Nixon (1998) states that competitive pressure leads the companies to reduce costs, decrease risks and shorten the development times in product development. Furthermore, product development has characteristics which are cross-functional. The actual performance of the offering development realizes after that product is launched, which makes the performance evaluation harder during the process. According to Taipaleenmäki (2014) early studies show, how management accounting techniques decrease the innovation in organizations. However, later studies show how management controls systems have advantages especially in innovation and uncertain environments.

The case organization is in the interesting phase as the organizational structure is changed recently from functional to the process view. Organizational structure is no longer vertical, instead it is horizontal and therefore presents the flow of processes. The measures for different core processes are needed to support the management of business processes. In this study, we will focus on the offering development process, which is described as cross-functional process in the functional view. The new measures objective is to support the horizontal view and new streams in the case organization. In addition, Langfield-Smith (2007, 73) argue that more research is needed about new management innovations such as total quality management (TQM), business process re-engineering (BPR) and continuous improvements in the field of management control systems. Langfield-Smith (2007, 65) also used the word operational strategies about these earlier mentioned management

innovations. Almost 15 years later, the study of Rashid and Hossain (2020) also emphasize the need for investigating and developing these new SMA techniques.

This thesis focuses on the development of performance measures to offering development process, which is one of the core processes in the organization X. The case organization uses the results of the study in developing the process performance measures further in analyzed process and in addition, in other core processes. Furthermore, the results of the study will help the case organization to identify issues related to current measures. In the current research literature, there is need for understanding the role of management accounting in operational strategies. This thesis' objective is to demonstrate, how management accounting can support the operational strategy by evaluating and developing measures for the case organization, which is emphasizing business process management. The case study indicates, how management accounting techniques are used in practice with management philosophies. Especially, the case study shows how management accounting techniques can support the process view of the organization. Furthermore, the thesis can give practical advices to organizations, where is considered to implement vertical organization structure instead of traditional functional structure.

1.1 Purpose of the thesis

The objective of this thesis is to research how the performance of offering development process can be measured in the case company. In addition, the purpose of the study is to produce practical conclusions how to measure core processes by analyzing one core process. Strongly future-oriented process is analyzed in this thesis. Objective of the study is to understand efficiency issues in the process and develop measures based on the current measures of the new product development process.

Purpose of this thesis is to answer question: How to develop performance measures for offering development process in the case organization?

In this study, the focus is on developing performance measures for the offering process. Implementing the measures to the organization is excluded from this study. Focusing only

to the offering development process in this study will enable researcher to gain deeper understanding about the process. Therefore, other core processes have been excluded from the research. In this study, the focus is on offering development process as it is the base for all the other core processes - without the product development, there is no product. Offering development process is crucial for success of sales, supply chain and after-market processes. Case study will give researchers practical insights about measuring business process performance, which is not commonly researched area in management accounting. Case division has changed their organization from functional to horizontal organization, which emphasizes the process view. This is especially interesting for the study.

Most important constructs for the thesis are process, offering development process, performance measurement and business process management. In this study process is defined as actions taken to achieve goals in business. Offering development process is defined as R&D process, where the focus is on developing new products and improving the products. Performance measurement is defined as measuring factors which will lead to better performance of the company.

1.2 Research strategy

According to Tuomi and Sarajärvi (2018, 18), qualitative research cannot be presented by using one objective definition, even though it is usually defined briefly in different research method handbooks. One of the characteristics of qualitative research is that the observations are based on theory, but the interpretations are subjective, which means that results are impacted by understanding of the researcher (Tuomi & Sarajärvi 2018, 20). Furthermore, the definition of qualitative research is also interpretation of handbook's author. Combining the information from different methodological handbooks without critical view is not reliable as the authors have different interpretations (Tuomi & Sarajärvi 2018, 18.)

Tuomi and Sarajärvi (2018, 18) argue that the relationship between qualitative research and theory is important when analyzing the nature of qualitative research. They

emphasize two questions: is theory important, when conducting qualitative research and, is qualitative research theoretical or empirical analysis? Tuomi and Sarajärvi (2018, 19) define the theory as the framework of the study, the theoretical part of the research in the text. The concept of theory is not easy to define clearly. Tuomi and Sarajärvi (2018, 19) state that the theory of the study consists of concepts and the relationships between different concepts. According to Tuomi and Sarajärvi (2018, 19), research is typically divided into two types of research: theoretical and empirical. This categorization is problematic, if theoretical research is understood as highlighting the theory and the empirical research is lacking the theory. In general, all research includes interpretations of human mind, which is characterized as theoretical. As earlier stated, the observations of researcher are based on theory. The interpretations are not objective, as the researchers make the decisions about the method based on their own understanding. However, all arguments are based on theory, which is the basis of the qualitative research. The categorization to theoretical and empirical can be simplified to difference between empirical data and argumentation. The analysis of data is divided to theoretical and empirical analysis. (Tuomi & Sarajärvi 2018, 20.) Empirical analysis emphasizes the methods for collecting and analyzing the data, whereas theoretical analysis emphasizes the argumentation through used references (Tuomi & Sarajärvi 2018, 21).

Tuomi and Sarajärvi (2018, 11) present seven different traditions of qualitative research to give understanding why the qualitative research is hard to define in one way. This thesis is based on the tradition of hermeneutics as the objective is to understand and interpret the research issue. (Tuomi and Sarajärvi 2018, 31) The thesis is also based on the tradition of action research. According to Tuomi and Sarajärvi (2018, 34), also action research has many different definitions. One definition is that action research is not one of the methods, instead it is strategic approach to the research. The research is highly influenced by the research topic. Defining action research as qualitative research is not problematic as action research can be defined based on the interest of information. Therefore, it can be defined as hermeneutical science based on the interest of practical information. (Tuomi & Sarajärvi 2018, 35.) These traditions are basis for this thesis because the researcher will make interpretations about the research data. Furthermore, the interest in this thesis is in practical information about the measurement in case division.

The thesis is conducted as a case study, where the focus is on one of the core processes of the division X. Lee and Humphrey (2017, 163) state that the definition of the case study has been debated in the management accounting literature. Llewellyn and Northcott (2007) define case study as a research design, which objective is to study certain phenomenon in a situation, where the context is hard to separate from the phenomenon. Lee and Humphrey (2017, 163) define the case study as Llewellyn and Northcott but do not limit the definition to include only one context and one case. The thesis is conducted as case study because evaluating and developing performance measures is impossible to separate from the context.

Salminen (2011, 6) defines literature reviews as descriptive, systematic literature reviews and meta-analysis. In this thesis theoretical framework is descriptive literature review, which is not limited by methodical rules. According to Salminen (2011, 6) descriptive literature review can be divided into narrative and integrative literature reviews. In this thesis the narrative literature review is used for theoretical framework of the study. The objective of narrative literature review is to conclude the previous studies and form a descriptive and coherent synthesis. (Salminen 2011, 7.) In this thesis narrative literature review builds synthesis about themes, which are studied in different research fields. In the thesis interviews and the documents created in division X are used as research data. In chapter three of the thesis, the empirical part will be presented in detail.

1.3 Outline of the thesis

In the second chapter of this thesis, the theoretical framework of the thesis is covered. The theoretical framework provides insights into the research and development and its relationship to management accounting. In addition, quality and process management is discussed after the nature of the offering development process. The theoretical framework continues by discussing about the management control systems, which provide context to business process management and developing the measures. Furthermore, the performance measurement in management accounting and management literature is covered. In the last chapter of the theoretical framework, the developing and managing performance measures for processes is discussed using the business process management approach.

In the third chapter of this thesis, the empirical part of the thesis is introduced. First, the execution of empirical part of the thesis is covered. In this chapter, gather and analysis of research data is described in detail and the reliability of the thesis is assessed. Secondly, the research data is presented. In this thesis case organization's documents, which have been analyzed, are introduced. In addition, the interviewees are presented. Furthermore, the reporting of the research data in the thesis is described.

In the fourth chapter of the thesis the empirical results are presented. In the chapter, the research data is described and analyzed. The fourth chapter is divided based on the findings in the thesis. First the offering development process and its context are introduced and analyzed based on the interviews and documents. Then the documents of the new product development process are analyzed to evaluate the NPD measures and identify root causes for deviations in the forecast and actual performance. Finally, the measurement challenges are discussed to develop the measures in the future.

In the fifth and final chapter of the thesis, there is discussion about the results. Furthermore, the conclusions based on the research findings are made. The chapter ends to the discussion of practical applications and the contributions to theory. In addition, the ideas for future research are presented in the closing paragraph.

2 THEORETICAL FRAMEWORK

2.1 Management accounting and R&D

According to Nixon (1998), competitive pressure on companies leads to product development to cut costs, lower risks and reduce development times. Product development faces the pressure for quicker results with higher efficiency. Nixon (1998) states that evaluating R&D activities is difficult as successful innovation involves many performance characteristics that are cross-functional. According to for example Taipaleenmäki (2014) and Nixon (1998), development of the new product leads to competitive advantage and determines the long-term performance of organization. Taipaleenmäki (2014) states that many academics agree with the importance of new product development (NPD) in organizations' success.

Management accounting can be seen undeniably one of the most important schemes for resource and process management (Taipaleenmäki 2014). According to early studies, the control systems of management accounting decreased the innovation in the organizations. The competitive edge in these innovative companies was in their advanced products, whereas accounting control systems were highlighting efficiency and productivity. These control systems were seen to aim only for lower price and cost minimization. Therefore, the role of control systems was found to be general and unconnected for R&D and innovation processes (Taipaleenmäki 2014.) The later studies show, how management control systems have advantages in innovation and uncertain environments. The new product development has both internal and external uncertainties and is often conducted in organizations, which are highly knowledge-based with the engineer-oriented culture. (Taipaleenmäki 2014.)

Taipaleenmäki (2014) states that if management accounting control systems are absent, often HR control is present. The most measured cost driver is headcount as it is easily observable and controllable. Taipaleenmäki's (2014) study shows that performance is rarely measured using management accounting reports and calculations in the case companies. Still different management accounting framework or ways of thinking were

adopted to new product development process and entire organization to increase knowledge about costs and profits, business itself and to improve performance. It's worth of investigating, how to combine control with flexibility and innovation. (Taipaleenmäki 2014.)

2.2 Quality and process management

In this chapter, the focus is on process management, which is defined as operational strategy by Langfield-Smith (2007, 65). First, the history of process-thinking and process management acronyms are presented briefly. Secondly, the quality management is defined to deepen the understanding about process thinking and managing processes. The objective of this chapter is to describe how business process management has evolved and how the idea behind the three-letter acronym is not a trend passing by (Jeston 2018, 12). Quality management is discussed using the literature from Juran, who is the pioneer of quality thinking.

2.2.1 The history and evolution of business process management

In the 1990's Davenport and Short (1990) present business process redesign (BPR). Davenport and Short (1990) state that IT is crucial when organizations are analyzing and designing their business processes. Business Process Redesign or later called Business Process Reengineering was also promoted by Hammer (1990). According to Hammer (1990) organizations should not automate their old processes when implementing new technology. Furthermore, organizations should redesign their processes to achieve expected improvements in their performance. Hammer (1990) describes BPR as "an all-or-nothing proposition with uncertain results".

According to Kaynak (2002), the total quality management (TQM) is a management approach which core idea is that organization will improve its performance continuously. TQM is important in every part of the supply chain and the quality is a key concept in every function of the organization. Kaynak (2002) states that earlier studies give mixed

results about TQM techniques' performance in organizations. Powell (1995) argues that the tools and techniques of TQM are not as important factors. However, executive commitment, open organization and employee empowerment improve the performance when organizations are implementing TQM. Other factors, such as process improvement or training were context-dependent and did not improve every organization's performance (Powell, 1995).

Lee and Dale (1998) state that in the end 1990's business process re-engineering (BPR) got a lot of attention in the field of business processes. They also argue that BPR often lead to a failure in the organizations which had implemented it. Process orientation had many terms in the early studies of processes, which were for example "process simplification", "process improvement", "process re-engineering" and "process redesign". (Lee & Gale 1998.) According to Hung (2006) Business process management has originated from Business Process Re-engineering (BPR) and Total Quality Management (TQM), combining the two approaches. According to Zairi (1997) BPM links organization's strategy to processes by measuring the process performance. BPM also encourages organizations to map and document their activities. Central ideas in BPM are continuous improvements through culture change, optimization and problem solving. BPM also inspires organizations to use best practices to gain advantage in the market. (Zairi, 1997.) DeToro and McMabe (1997) argue that BPM strengthens employee commitment because process owners and workers take more responsibility of their own work. Lee and Gale (1998) summarize BPM as a customer-focused approach which improves processes with cross-functional teamwork and employee empowerment by systematic management and measurement.

Hung (2006) highlights how organizations' strategy works as a base for business operations in BPM approach. Also, involvement of people is seen as key concept for business process management. In addition, BPM has corporate-wide impact as it affects the structure and the management of organizations. Furthermore, process leaders manage the organizations differently than functional heads. According to Hung (2006), the whole organization performs better if leaders and employees are committed to change. Business process management, as every other change program, needs senior managers' support to function (Ulrich, 1997). Hung (2006) concludes that BPM covers two themes which

improve organizational performance. These themes are process alignment and people involvement.

2.2.2 Quality management

According to De Feo and Juran (2014), there are two important matters to consider, while managing quality. Firstly, quality is related to customer satisfaction of products' features and how well the product meet customer needs. Secondly, quality refers to situations where there is no deficiencies. The first statement refers that higher quality costs more and on contrary, the second statement refers that higher quality costs less. De Feo and Juran (2014) state that organizations can master quality by planning, controlling and continuously improving it. These are Juran's universals of managing quality.

According to De Feo and Juran (2014), there are different brand names for methods of managing quality. For example, Lean six sigma and Total Quality Management (TQM) are brands, which have been developed based on Juran's universals. New brands are founded as the quality management is used for example in new industries and countries to mention few examples. De Feo and Juran (2014) state that new brands are often useful as organizations improve their performance by managing the quality with brands. Developing new brands based on the previous ones is often positive. There might also be negative outcomes in the brand development, for example with the brand TQM, which was the top brand in 1990's. It was replaced with six sigma, which was more oriented to business and easier to measure. De Feo and Juran (2014) argue that the brands, which currently are the most used in organizations, will change over time, developed further to new brands or be replaced as well. In addition, they state that it does not matter which method the organization is using if the emphasis is on managing quality processes. For example, some organizations find still Total Quality management (TQM) the best method for them. (De Feo & Juran 2014.) Also, many academics in management accounting are referring to TQM, while discussing about quality management. (For example, Hoque 2014.)

As earlier stated Juran's trilogy consists of quality planning, control, and improvement. De Feo and Juran (2014) state that these three managerial processes are based on financial processes, which are universal in all organizations. This means that they are used similarly

in every organization for financial management. According to De Feo and Juran (2014), quality planning includes for example establishing process controls and determining customer needs. Quality control includes for example measuring actual performance, comparing it to the targets and goals, and maintaining performance. In addition, quality improvement includes for example establishing project infrastructure and identifying the improvement projects. (De Feo & Juran 2014.) These all processes have relationships between each other. Quality control is the most important stage in this thesis, but the other dimensions should be considered as well. Quality planning is done as financial budgeting, quality control is done continuously during operations and quality improvements are done based on the quality control. Quality improvements have impact on quality planning as the learning happens in the organization through improvements. (De Feo & Juran 2014.)

Quality is important factor in managing processes as business process management emphasizes many things, which are highlighted also in quality management. Furthermore, the context is crucial for process management as processes are organization specific. Therefore, certain measures work only in the organization, where they have been developed. In the next chapter of this thesis, management control systems (MCS) are discussed. Furthermore, MCS define the organization and vice versa: the organization defines management control systems.

2.3 Management control systems

According to Malmi and Brown (2008), management control systems (MCS) have different definitions used by researchers. Diverse definitions of MCS have raised issues in the literature as some definitions are very different from each other. Malmi and Brown (2008) state that some researchers, for example Chenhall (2003), define the term management control system very broadly, meaning that almost every control in the organization is a part of the management control system. Mercant and Van der Stede (2017, 11) defined management control system as dealing with employees' behavior. They state that in the organizations people are the most important resource and they behavior is affecting most to the performance of the organization. Merchant and Van der Stede (2017, 11) also argue that if people are always behaving in the best interest for organization, management

control systems are not needed. Furthermore, employees are self-interested. According to Malmi and Brown (2008), some researchers, for example Flamholtz, Das and Tsui (1985), define controls as means for organization to achieve its goals. Flamholtz et al. (1985) define organizational control systems as processes and techniques to reach the targets in all levels. In their view, organizational control, including for example rules, is broader than organizational control system, which only object is to achieve the goals. According to Malmi and Brown (2008), different definitions lead to different conclusions in the field of management control systems.

Malmi and Brown (2008) define management control systems as control systems directing employee behavior. When management directs employee behavior with, for example systems, values and rules, these actions are called management control. Furthermore, management control systems are complete systems and not simple rules. If there are systems, which help employee to make decision in any organizational level, but these systems are not monitored, then the systems are called management accounting system. These management accounting systems provide information (Malmi & Brown 2008.) Malmi and Brown (2008) use the concept of management controls or MCS rather than organizational control, which also includes inventory and quality controls. These controls are not directed to employees. Malmi and Brown (2008) emphasize that differences between definition are easier to separate analytically than in empirical studies. They use planning as an example. The planning has two tasks: support decision-making and help to achieve organization's goals. The first task is not management control, but the second one is. If the planning only supports decision-making, it is not defined as MCS. Malmi's and Brown's (2008) example about cost control is good to demonstration, how the same action can be either management control or organizational controls depending employees' behavior. If subordinates restrict travelling, when a superior requires reporting about costs relative to budget, subordinates change their behavior based on the requirement. This accountability lead subordinates to control costs by themselves, which can be labeled as management control. (Malmi & Brown 2008.)

The idea of management control system is not innovative as in the research literature the term has been used for decades. Furthermore, the idea of studying management control systems as a package is not new as the researchers have identified that management control systems do not function in isolation from other systems. Before Malmi and Brown's

(2008) typology, only little theorizing or empirical research was conducted about the management control systems working as package. Nevertheless, the need for the study was raised often in the literature (For example, Alvesson & Karreman 2004). According to Malmi and Brown (2008), it is important to study MCS as a package of systems rather than study only one management control system. They argue that studying the systems as whole has many reasons.

First, according to Chenhall (2003), themes and practices of management control systems might seem to be independent systems in isolation from each other and can be separated from the context but in fact the MCS's are part of broader control system. Chenhall (2003) argue that there is no evidence of certain management control systems, which would fit for certain organization type, or of system, which would be the best fit for improving performance in every organization. Secondly, Malmi and Brown (2008) state that accounting researchers have studied widely different innovations, for example Balanced scorecard (BSC) and activity-based costing (ABC). The objective of those studies is to explain the design, implementation, use and influence of the innovations. Nevertheless, innovations always work in different contexts in these studies and are part of the organization's existing control systems. Therefore, the conclusions of these studies are influenced by the package of management control systems. Malmi and Brown (2008) argue that management accounting systems theory focuses on designing the management control system, which support organizations' goals. The third reason for studying management control systems as a package is that major management accounting literature focuses on accounting-based controls, which are typically formal ones. Further information is needed to understand the different types of controls and their impact on innovations, for example BSC and ABC. This would improve the theories about designing management control systems for organizations to achieve their goals. Furthermore, the conclusions about innovations would be more accurate. (Malmi & Brown 2008.)

It's beneficial and necessary to study management control systems as a package, but at the same time, there are challenges. Malmi and Brown (2008) list three of these challenges in their article. First, it is hard to define what is management control system. As earlier stated, researchers have used different definitions for MCS. It is important to define what is management control system and what is information system or system supporting decision-making. The latter systems are not management control systems.

Furthermore, it's crucial to define what management system is controlling. Is MCS controlling human behavior or artefacts, for example cash or material flows and which level the system is controlling. Different levels can be for example entire organization, business unit, division, managers, or individuals. (Malmi & Brown 2008.) Or in the scope of this thesis, systems can also control processes. Secondly, when defining the package of MCS, it should be considered what to include and exclude in the package. As earlier stated, every control has impact on other, which leads to situation where one control cannot be studied without the context. The third challenge is that as management control systems are often very large and complex, empirically MCS are hard to study. In the field and case studies, researchers find difficulties with making sense of the system and reporting it in their article in a way that is understandable for readers. (Malmi and Brown 2008.)

Malmi and Brown (2008) present their typology of package of management control systems, which objective is to act as framework for empirical management control system studies. Malmi's and Brown's (2008) frameworks differs from Merchant's and Van Der Stede's object of control framework (2017, 19). Both frameworks are presented in this thesis and the differences are emphasized. Malmi and Brown (2008) divide the five types of control into planning, reward and compensation, cybernetic, administration and cultural controls. However, Merchant and Van der Stede (2017) use the object of control framework, which divides the controls into results, action, personnel and cultural controls.

When discussing about measuring process performance, the most important type of controls are cybernetic controls in the framework of Malmi and Brown (2008). Measuring performance is defined as results control in the framework of Merchant and Van der Stede. According to Malmi and Brown (2008) cybernetic systems are divided into budgets, financial measurement systems, non-financial measurement systems and hybrid measurements systems, which include both financial and non-financial measures. For example, Balanced scorecard and Table de Bord are hybrid measurement systems. Cybernetic systems are strongly associated with control as they give feedback about performance. It is worth to notice that cybernetic systems can be defined as information systems or control systems depending is the information from the system used for decision-making or linking the information to employee behavior. If manager is using the same variance information for decision making without anyone else's involvement, it's information

system. Furthermore, cybernetic system is a management control system, if the measures form the system are linked to targets and employees are accountable for the variations. If employees are accountable of the measures, they will change their behavior to improve the performance. (Malmi & Brown 2008.) Financial measures have been used for control longer, but also non-financial measures have become more crucial to organizations. Malmi and Brown (2008) state that other management philosophies, such as total quality management (TQM) have increased the use of non-financial measures. Balanced scorecard is the most studied and used framework of hybrid performance measurement systems. (Malmi and Brown 2008.)

Furthermore, administrative controls and cultural controls have value in the measuring process performance. According to Malmi and Brown (2008), administrative controls are divided into three controls, which are organization design and structure, governance structures and the procedures and policies. Some researchers consider organizational design as contextual variable, but Malmi and Brown (2008) state that manager can change the design. Therefore, it's part of management control systems. The policies and procedures are used to specify processes in the organization. Merchant and Van der Stede (2017, 90) define procedures and policies as action controls. Malmi's and Brown's (2008) administrative controls are wider than action controls in the object of control framework.

Organizational culture can be seen shared values, beliefs and norms in the organizations. The organizational culture has impact on employees thinking and behavior. (Malmi & Brown 2008.) The cultural controls are divided into value-based, symbol-based and clan controls. These controls work in three levels: organization can recruit people, who share organization's values; employees modify their values through socialization in the organization or employees behave according to values, even though they do not personally share them. (Malmi & Brown 2008). According to Merchant and Van der Stede (2017, 222), cultural and personnel controls should be initial consideration for management controls as they are cost-efficient and do not have many harmful sides. In many situations cultural controls are not sufficient by themselves but should be supplemented with other forms of control (Merchant & Van der Stede 2017, 223). Merchant & Van der Stede (2017, 103) state that cultural controls have become more crucial for organizations as companies empower employees instead of having hierarchies and bureaucratic action controls. The management controls have diverse purposes and are used for different time

periods. Malmi and Brown (2008) state that cultural controls are slow to change and subtle. Administrative controls provide structure for other controls. Planning, cybernetic controls, reward and compensation are contemporary and should be evaluated from time to time.

Merchant and Van der Stede (2017, 20) emphasize financial results control in their text, but also provide information about other controls. As earlier mentioned, their framework, object of control is divided to results, action, personnel and cultural controls. They have also identified control problems and recognized which control is suitable for each control issue. Merchant and Van der Stede (2017, 12) divide control problems as lack of direction, motivational problems and personal limitations. When employees are lacking direction, they are not aware of what the organization is expecting from them. Motivational problems occur when employees' and organizations' goals do not naturally meet as employees are self-interested. The primary focus is on motivation in effective management control system. Therefore, the most common control system to answer motivational problems are results controls with good combination of action and cultural controls. (Merchant & Van der Stede 2017, 12-14). According to Merchant and Van der Stede (2017, 14), employees have personal limitations, when there are other limitations than lack of direction or lack of motivation. These can be for example training or experience related issues.

Results controls are important part of management control systems as they emphasize employee empowerment, which has been highlighted by management philosophies since 1990's. (Merchant & Van der Stede 2017, 34) Empowering employees is crucial for success of quality and process management philosophies (Hung 2006, De Feo & Juran 2014). According to Merchant & Van der Stede (2017, 35) results controls are important, when controlling professional employees, who have decision authority. With results controls, organization gives employees power to take actions and make decision that employees think will lead to desired results. In addition, according to Merchant and Van der Stede (2017, 38) results controls can be used for their cybernetic nature, which means that measures used as results control give feedback. This is called management-by-exception when performance deviates from expected and it's investigated. (Merchant & Van der Stede 2017, 38.) Malmi and Brown (2008) emphasize the cybernetic nature of performance measurement in their framework. Furthermore, results controls are not used in isolation and do not work in every situation. Results controls are successful, when the

definition of desired results is clear, and the results are measured accurately. (Merchant & Van den Stede 2017, 34.)

According to Merchant & Van der Stede (2017, 38), implementing results controls have four elements, which are defining performance dimensions, measuring performance, setting performance targets, and providing rewards. In the scope of this thesis, measuring performance is the most important element, but others are crucial for the total success of implementation. By defining performance dimensions, organizations define the desired results. Furthermore, defining right performance measures is as crucial as defining performance dimensions. Merchant and Van der Stede (2017, 38) state that what you measure is what you get. This means that measures should be aligned with chosen dimensions as employees view about what is important is shaped by measurements and goals. Furthermore, employees try to improve measured performance, even though it might not have positive impact on desired performance. (Merchant & Van der Stede 2017, 38.)

If measures are not aligned with performance dimensions, it is possible that unintended consequences occur. Therefore, measures are critical for results control system. (Merchant & Van der Stede 2017, 39.) The performance of, for example organization, employee or process can be evaluated using measures. Financial measures are often regarded as objective measures, but there are also some nonfinancial objective measures, such as market share and customer satisfaction. Performance can also be evaluated by using subjective measures. Merchant and Van der Stede (2017, 39) state that different organizational levels use different type of measures. Financial goals should be translated to operational goals to improve communication from management to employee level.

As earlier mentioned, setting performance targets and providing rewards are also important for implementing results control system (Merchant & Van der Stede 2017, 38). Performance goals have impact on employee behavior as firstly, they improve motivation of people. Most of the employees perform better if they work for specific goal. Secondly, performance targets give employees opportunity to evaluate their own performance. Employees understand and respond to feedback better, if they can interpret it by comparing actual performance to targets set. (Merchant & Van der Stede 2017, 40.) Rewards can be for example bonus, training opportunity or recognition. The most important feature of reward is that employees value the reward. Organizations can offer extrinsic rewards,

which are either monetary or non-monetary. However, results controls can also offer intrinsic rewards when people have achieved the goals. Employees themselves feel the sense of accomplishment when they have worked for the desired result, which improves the motivation. (Merchant & Van der Stede 2017, 40-41.) According to Merchant and Van der Stede (2017, 222), results accountability offers solutions to lack of direction and motivational problems.

According to Merchant and Van der Stede (2017, 42), there are three conditions, which determine the effective use of results controls. Firstly, the organization must be aware what are the desired results and communicates those results to stakeholders. This is harder than often expected as different organization levels face different situations, which possibly leads to compromises. Organization should translate the objectives to specific expectations to employees. If the measures are not aligned with organization's strategy, employees might behave in an undesired way. (Merchant & Van der Stede 2017, 42.) The second condition determining results control effectiveness is controllability. Furthermore, the results measures should indicate are the actions or decisions desired. If the measures are uncontrollable, they do not give any information about the success of actions or decisions. Organizations always face some uncontrollable factors, but for results controls to be effective, the unnormal and unreasonable factors should be separated from the results for better evaluation. In addition, employee, who is accountable for the results must have chance to make a change to measure by actions. (Merchant & Van der Stede 2017, 42-43.) Thirdly, organization must be able to measure controls effectively. (Merchant & Van der Stede 2017, 43). The measurement issues raising from ineffective controls are covered in the chapter 2.4.3.

2.4 Measuring performance

Performance measurement gained more attention since early 1980's as the traditional control management, which focused on financial measures, did not meet the demands of modern management (Endrikat, Guenther and Titus 2020). According to Hoque (2014), scholars such as Kaplan and Norton stated that managers concentrate on short-term benefits instead of long-term prospects, when they are focusing only on financial measures.

Furthermore, Kaplan and Norton among other scholars promoted the use of non-financial measures in addition to financial ones when evaluating an organisation's performance. Non-financial measures are operational measures which can be for example the amount of on-time deliveries, decrease in process costs and cycle time. (Hoque 2014.)

According to Taticchi, Balachandran and Tonelli (2012), the ideal performance measurement system has five milestones, which are assessment, design, implementation, communication and alignment, and review. In the assessment stage, the current system should be evaluated for the basis of planning the new system. Improvements can be made based on the assessment; therefore, the first stage is crucial. Design of the performance measurement system is the second milestone. System is organisation specific, therefore the system should be designed to reflect the organisation's business. In the design phase, frameworks offer different solutions for choosing relevant measures. Key elements from different frameworks are evaluation of relationship between strategy and operations, stakeholder views, financial and non-financial measures and use of external and internal measures.

The next milestones are not as relevant to the study as the first ones, but they are important for successful use of measurement system. Implementation is important stage, where many frameworks tend to fail, including Balanced Scorecard. (Taticchi et al. 2012.) The most important elements for implementation according to Franco-Santos and Bourne (2005), are top manager commitment, empowerment of employees and effective communication process. Also, business process management emphasizes executives' commitment and empowerment of employees in organizations. According to Taticchi et al. (2012), the fourth milestone is communication and alignment, where effective communication of performance leads to alignment in company. This is crucial for the organization's strategy. The fifth milestone is review of the performance measurement system as the environment or organization's strategy change over time. The goal of the system is overall and continuous improvements; therefore, measurement system should be reviewed from time to time. (Taticchi et al. 2012.) In this study, I focus mostly the design of the performance system.

The design of the performance measurement system can be hard to define (Neely, Mills, Platts, Richards, Gregory, Bourne and Kennerley 2000). Companies find the adoption of the framework as Balanced Scorecard hard as the frameworks give suggestions about the

areas to measure, but no further guidance how to recognize and manage the business using these measures. (Neely et al. 2000.) Taticchi et al. (2012) also states that frameworks tend to fail in aligning the performance measurement system to management system. Then the companies' goals and targets are hard to achieve. According to Neely et al. (2000), the practical value of the frameworks should be recognized by understanding the process of implementing the framework. Neely et al. (2000) develop a populated process for implementing performance measurement frameworks. The results of the study suggest that the process is too complex and different organizations cannot apply the same process when designing their performance measurement system.

Neely et al. (2000) introduce many performance measurement frameworks, which were introduced at the latest in the end of 1990's. To list the most relevant frameworks for the thesis, Neely et al. (2000) mention four performance measurement frameworks, including balanced scorecard by Kaplan and Norton. The two frameworks, Neely et al. (2000) mention, focus on business processes. Taticchi et al. (2012) mention also many other frameworks for measuring performance, for example Activity-Based costing and management (ABC and ABM), the customer value analysis (CVA), the return on quality approach (ROQ) and The Business excellence model (BEM) to mention some. These all are different brand names for frameworks or tools to support performance measurement. In their article, Taticchi et al. (2012) have listed 25 different performance measurement frameworks or tools, which all can also be impressed as acronyms.

Balanced scorecard is often mentioned when discussing about performance measurement. Neely et al. (2000) state that Balanced scorecard is the most popular even though BSC is only one of the many frameworks. Neely et al. (2000) argue that reason for its popularity is that major consulting companies promoted the framework in the 1990's. Neely (2005) state that Kaplan's and Norton's Balanced scorecard was the most cited article in the field of performance measurement in 2005. Still after over 25 years the balanced scorecard is the most popular and studied framework (Hoque 2014; Rashid & Hossain 2020).

As earlier mentioned, new frameworks have been developed throughout the years. Furthermore, the scholars don't find one optimal framework for companies. Neely (2005) argue that there are reasons, why performance measurement hasn't reached it academical professionalism in the early 2000's. One of the explanations is that the most cited authors

in the field have diverse backgrounds in the fields of accounting, information systems, operations management or operations. Integrating the gained knowledge in different fields and making performance measurement coherent and agreed field of study, is a challenge. Endrikat et al. (2020) state that there is no consensus about the strategic performance measurement. According to Neely (2005), all the scholars try to solve the same issue, which is related to organization's strategy and performance measurement. Neely's (2005) study has been conducted in the early 2000's and therefore, the study field of performance measurement has been relatively new then.

According to Neely (2005), the future focus should be in dynamic rather than static performance measurement system. Relationships between different dimensions in organizations are not logical and linear. Neely (2005) also states that organizations should be more focused on managing the performance than just measuring it. Performance measures are the tool, not the way to improved performance. Also, Taticchi et al. (2012) argue that instead of only measuring performance, organizations should focus on performance management. Organizations' environment is constantly changing, which raises concerns about how to make performance measurement systems flexible (Neely 2005). Already when developing the system, changes occur. Neely (2005) also questions how performance measurement systems value intangible assets as human and social capital.

In the end of 1990's the frameworks were presented, but practical process for designing the performance measurement system was not given in the studies (Neely et al 2000). The frameworks drew attention to linking strategy to measures, both financial and non-financial. The frameworks did not present, how to identify and manage the right measures. Neely et al (2000) state that academics had discussed about how to decide the right measures for organization, but the discussion was superficial.

2.4.1 The framework of balanced scorecard (BSC)

According to Hoque (2014), many frameworks were developed and published in 1990's. The most popular framework was Balanced Scorecard, which was introduced by Kaplan and Norton in 1992. Balanced scorecard is based on Kaplan's and Norton's research inside twelve companies, which lasted one year. (Hoque 2014.) Hoque (2014) states that

Kaplan & Norton have published ten articles and five books following the first article in 1992 about Balanced Scorecard. They studied over 300 organizations after introducing Balanced Scorecard. According to Hoque (2014) Balanced scorecard has gained massive attention from academics and industrial communities in 20 years from 1992 to 2012 (Hoque 2014). As earlier mentioned, Balanced Scorecard is just one of many frameworks. It's not the only framework, which links the strategy to performance measures and combines financial measures with non-financial ones. In fact, the French are known to have comparable framework of Tableaux du Bord. (Hoque 2014.) Kaplan and Norton developed their framework continuously and marketed the model extensively.

Originally in 1992 Balanced scorecard combined financial and operational performance measures by dividing the measures to three perspectives, which were customer satisfaction, internal business processes and, innovation and learning (Hoque 2014). Kaplan and Norton (1996) updated the three perspectives into four, which are financial, customer perspective, internal business processes and, organizational learning and growth. They re-arranged the innovation element from innovation and learning to internal business processes. (Hoque 2014.) They also showed the cause-and-effect relationships between the perspectives. Furthermore, they divided measures to outcome measures and performance drivers for the outcomes. Kaplan and Norton (1996) state that measures of organizational learning and growth impact the outcome and measures of internal business processes, which have impact on customer perspective outcome and measures. Furthermore, the measures of customer perspective have effect on financial measures, supporting the causal relationship.

According to Kaplan and Norton (1996), financial indicators are usually common and lagging measures, which means they cannot be changed afterwards. Furthermore, non-financial measures are usually unique and leading measures. Kaplan and Norton (2008) highlight the strong linkage between measures and strategy map. The measures based on strategy will support organizational goals as employees work for improving the measures, which are improving the performance related to organizations' strategy. According to Hoque (2014), the business environment is changing very fast, furthermore, organization must measure, monitor and manage the performance better than earlier. The most important matter is that strategy and operations are integrated. Neely (2005) state that performance measurement system should be dynamic rather than static system. Also,

Taticchi et al. (2012) argue that companies should move from measuring performance to managing performance. Furthermore, Kaplan and Wisner (2009) state that measures should be divided into financial and non-financial in a way that management is effective. This means aligning the information, communication, and strategy in the all levels of the organization.

Originally Balanced scorecard was developed by Kaplan and Norton to measure performance of the organization by measuring financial and non-financial things. Nowadays the framework is tool for implementing strategy and managing the organization (Hoque 2014). Furthermore, according to Malmi (2001), companies are using the Balanced scorecard for five different reasons, which are moving strategy from visions to actions, managing quality, supporting changes, following managerial trends and moving from traditional budgeting. According to Hoque (2014), research should focus linking the balanced scorecard framework with other strategies and management philosophies such as Total Quality Management (TQM).

2.4.2 Management accounting and quality

Quality has gained a lot of attention recent years as it can be seen a competitive edge for many companies. Focus on the quality can lead to cost reduction and increased customer satisfaction. (Bhimani, Datar, Horngren & Rajan 2018, 636.) According to Bhimani et al. (2018), quality can be discussed using the four perspectives from balanced scorecard, which are financial, customer, internal business process and, learning and growth. This way of presentation shows, how the management accounting academics can structure quality management through well-known framework. This is practical approach for measuring quality.

The financial perspective of quality concerns the costs of quality (COQ). (Bhimani et al. 2018) These costs arise from preventing poor quality when those are prevention or appraisal costs. Costs of quality may also be result from internal or external failures when costs are result of poor quality. According to Bhimani et al. (2018, 637-638) prevention costs occur, when products do not meet the specifications. Prevention costs rise from for example design engineering, quality engineering or from using new material in

manufacturing the product Appraisal costs are the costs from detecting, which products do not meet the specifications. For example, inspection and product testing are appraisal costs of poor quality. Internal and external failures rise when the product does not meet customer needs. Internal failure costs are for example rework and breakdown maintenance. These costs rise before the product is shipped to customer, whereas external failure costs occur, when customer has already received the product. Customer support and warranty repair costs are examples of external failure costs. (Bhimani et al. 2018, 637-638.) These costs make costs from poor quality visible to the organization.

According to Bhimani et al. (2018), customer perspective shows how satisfied the customers are to the product quality. As Kaplan & Norton state (1996), the perspectives have cause-and-effect relationships. Greater customer satisfaction will lead lower external failure costs and decrease costs of quality in total. In the customer satisfaction decreases, the costs of quality will increase in the future. Therefore, higher customer satisfaction will increase financial performance. The satisfaction of customers can be tracked by using measurements of, for example, market share, the count of customer complaints and percentage of on-time deliveries. (Bhimani et al. 2018, 640.)

The internal business process perspective helps to improve quality by identifying and analyzing the problems with quality. Improving quality leads to improved customer satisfaction as there is causal relationship between customer and internal business process perspectives. (Bhimani et al. 2018, 640.) This perspective is the most valuable for measuring process performance. Other perspectives support the process measuring. According to Bhimani et al. (2018, 640), the tools for identifying and analyzing the quality issues are control charts, Pareto diagrams and the diagrams of cause-and-effect. The internal business process quality can be evaluated by using different kinds of non-financial measures. For example, organization can measure the number or percentage of products, where rework is demanded.

Measuring learning and growth perspective will lead to quality improvements in internal business processes (Bhimani et al. 2018, 642). This causal relationship was also stated by Kaplan and Norton in Balanced scorecard (1996). The drivers and measures for improving business process quality are also based on organization's analysis. (Bhimani et al. 2018, 643) There is no driver, which fits for all organizations, as issues are organization

specific. For example, organizations use measurements of percentage of employee training, ratio of employee turnover and ratio from employee satisfaction surveys.

Measuring quality can be done with both financial and non-financial measures. Calculating costs of quality are financial measures and other perspectives use non-financial measures. Both have advantages and disadvantages, but organization benefits the most for using both financial and non-financial measures. (Bhimani et al. 2018, 646.) The benefits for financial costs of quality measures are, for example, that COQ is good tool for setting goals to achieve maximum cost reduction. Furthermore, measuring costs of quality gives an overview of quality performance. On the other hand, non-financial measures of quality are usually understandable and simple to quantify. Also, non-financial measures address the physical processes and give quick feedback on whether the actions improve the performance. (Bhimani et al. 2018, 646.)

2.4.3 Measurement issues

Usually always something can be measured, but in all cases, results cannot be measured effectively, which means that measures do not direct employee behavior to wanted direction. Furthermore, effective measures are congruent with the performance dimension and therefore, have positive impact on employee behavior. In addition, measures of the results must be precise, objective, timely, understandable and cost efficient. (Merchant & Van der Stede 2017, 43.)

According to Merchant & Van der Stede (2017, 43), measures always contain some degree of error, which can be either random or systematic. Accuracy of the measurements refer how close the measure is to the true and actual value. However, precision means that measurements show the same value under similar conditions. Furthermore, measures are reliable when they show same results under similar conditions. (Merchant & Van der Stede 2017, 43.) By reducing systematic error, measures can be more accurate, but without being precise, measures are unreliable. Therefore, accuracy cannot be achieved without preciseness. When measures contain systematic error and therefore are biased, they still can be precise. However, biased measures might not be good for controlling, especially if the systematic error is not known. Precision is crucial for measures as without it

measures can lose their value to the organizations. Employees are not satisfied if the same performance is evaluated differently. Subjective measures are difficult to measure precisely as they often contain systematic or random errors. (Merchant & Van der Stede 2017, 44.)

The measure is objective when it is unbiased. It's lacking for example influence of personal feelings or interpretations. Measurement, which objectiveness is in low level, can be precise but not accurate. Low objectivity may occur when people, whose performance is evaluated, themselves report the performance, calculate the measures or have considerable power over the decision of measurement methods. The objectivity can be increased either by measurement done by independent parties, who not generate the results or measurement verified by independent parties, such as auditors. For example, controller function can calculate the measurements inside the company for increasing the objectivity. (Merchant & Van der Stede 2017, 44.)

According to Merchant & Van der Stede (2017, 44), there is a lag between performance and the measurement of performance. Timeliness refers to this time between the measure and the result. Firstly, timeliness is important quality for measurement as employees have higher motivation if they are reminded about performance more often. Some amount of pressure can encourage employees to be more creative with their working habits to improve performance. Furthermore, if time passes between the feedback, for example measure, and the performance, measures have no impact on employees' behavior. Secondly, timeliness is crucial as measures can be cybernetic controls. If results are measured on time, the problems can be fixed. (Merchant & Van der Stede 2017, 44.) For example, the process can be fixed before the damaging step causes more harm.

Measures must be easy to understand to achieve the desired results. First, employees must know and comprehend what results they have accountability of. Communication is the key element for understandable measurements. (Merchant & Van der Stede 2017, 44.) Secondly, employees should comprehend, how to influence the results by their own actions, at least in bigger picture. For example, employees, who are held accountable for customer satisfaction, should be aware of the values and expectations of customers and develop strategies in order to improve customer satisfaction. Right measures can empower employees as they develop own ways to achieve the goals assuming employees

understand what the measure is about. The empowerment is one advantage of results control as employees themselves improve performance. Good control is achieved without managing employees' every action. (Merchant & Van der Stede 2017, 45.)

Measures should be precise, objective, on right time and comprehensible. Merchant and Van der Stede (2017, 45) argue that in addition, measures must be cost efficient. The costs arise from using and developing the measurements. The benefits of the measures should be higher than the costs of the measures. In other words, measures with highest net benefits should be implemented to the organization. Many times, assessing measures is not easy as measures are not only good or bad. Often compromises must be done, when measures are developed as all qualities might be impossible to achieve. For example, measure can have other qualities, but it has long gap between the performance and the point of measurement. (Merchant & Van der Stede 2017, 45.)

Merchant & Van der Stede (2017, 227) state that there are benefits and disadvantages in results controls. One of the benefits is that employees can be controlled in a situation, where they have great autonomy. This is especially the case when creativity is expected from employees. Autonomy leads to employees being more committed and having higher motivation through the need of self-accomplishment. In addition, results controls enable employees learning by doing and learn from their mistakes. The unique and personal way of doing will be developed by employees and this can lead to better performance. (Merchant & Van der Stede 2017, 227.) Furthermore, one advantage of results controls according to Merchant and Van der Stede (2017, 228), is that they can be inexpensive compared to for example action controls. This is the case, when measures are collected for other purposes, such as financial reporting or developing strategy.

Results controls also have few disadvantages or, in other words, limitations (Merchant & Van der Stede (2017, 228). Firstly, as discussed earlier, the measures do not always meet the qualities of good measures. Furthermore, this leads measurement issues, where the performance is hard to evaluate as it is not certain have the good actions been taken. Second limitation of results control is in the situation, where measures are affected by anything other than employees' own skills and actions. Measures can be affected by noise, which is an uncontrollable factor, for example environmental uncertainty. Thirdly, setting performance targets for measures is hard as the functions of controls can be conflicting.

Control functions are divided to motivation-to-achieve, planning and coordination. For increasing motivation, the targets should be challenging but possible to achieve and for planning, the targets should be realistic. Furthermore, for coordination the targets should be maybe even conservative as the coordination function is important for forecasting as an example. (Merchant & Van der Stede 2017, 228.) Other entities or in the process view, streams, should be aware, what to expect from other streams to achieve organizational targets.

According to Merchant & Van der Stede (2017, 231), the perfect management control system for all situations and environments does not exist. Firstly, the employees, their behavior and attitudes have great impact of the success of the management control system. Secondly, one issue for failed management control system is the changing environment or fast growth of the organization if the situation is not understood well enough. (Merchant & Van der Stede 2017, 231.) Furthermore, management control system cannot be maintained the same for long periods of time, especially if the organization is acting in changing market and environment. In addition, evaluating management controls systems is hard as seemingly insufficient control systems can prevent many harmful side effects. (Merchant & Van der Stede 2017, 232.)

2.5 Performance measurement of business processes

Often business processes are characterized as complex, broad, and cross-functional. According to De Feo and Juran (2014), extensive results can be achieved only when managing those processes. Over time, neglecting processes can lead the processes to be, for example excessively slow, too costly, and obsolete. The environment is changing constantly, and processes should respond to the changes to perform successfully in competitive markets. Business process management is especially crucial for success of information technology (IT). With good business process management, technology enables organizations to automate business processes and solve problems. (De Feo and Juran 2014.) In this thesis, the focus about business process performance measurement is on the views of De Feo and Juran (2014) and Rummler and Brache (2013) as they can be seen pioneers in the field of quality and process thinking.

According to De Feo and Juran (2014), business process management helps organizations perform well with the ownership of processes, which means that some people in the organization are accountable for the most crucial business processes. Historically organizations are managed by functional departments. Therefore, managerial actions have flowed vertically through hierarchy. However, processes flow horizontally in the organization from one functional department to the other. (De Feo & Juran 2014.) Managers are accountable for the function but not for the process, which develops issues in the overall process between functions and the departmental goals. The ownership and moreover the accountability of the process decreases the cross-functional issues, which are not easy to observe.

When managing business processes, organizations must identify the key processes, which give the most value to customer. The processes are based on organizations' strategy. (De Feo & Juran 2014.) The key processes have process owners, who are accountable for the process performance and improve the three dimensions of process: effectiveness, efficiency, and adaptability. Furthermore, two-tier ownership of the process can be applied, especially in the complex processes. The executive owner operates as sponsor and is responsible for process results. There is also an owner in the working level, who is accountable for daily operations. The advantage is that there is management's support in parallel with practical involvement. (De Feo & Juran 2014.)

De Feo and Juran (2014) state that the process performance can be measured by using three dimensions, which are effectiveness, efficiency, and adaptability. The process is effective when the output satisfies customer. In addition, the process is efficient, when the customer is satisfied with the lowest costs. Furthermore, process is adaptable, when it stays both effective and efficient, when changes occur. (De Feo and Juran 2014.) Measuring the process performance is important during the planning but also continuous measurement is crucial for the success of the process. With process measurement, emphasis is on effectiveness and efficiency measures. De Feo and Juran (2014) state that quality control techniques are crucial for improving process performance. Processes are improved by using quality improvements tools to decrease deficiencies. Furthermore, managing business processes is not done once, but continuously by reviewing process performance to maintain competitive. (De Feo & Juran 2014.)

According to De Feo and Juran (2014), it's crucial to measure the process performance to manage quality of the process. The process performance measures, which are based on the customer needs, measure the effectiveness of the process. For example, if customers require on-time delivery, process can be measured by using the percentage of on-time-deliveries or the number of delivery days. Measurement data should be base for the analysis, lead to problem solving and continuous improvements. (De Feo & Juran 2014.) Process efficiency is measured using cost, cycle time, productivity of labor and process yield measurements. For example, the goal is to reduce rework in the process by 20 %. The goal cannot be achieved, if causes for the rework are not identified. To improve the process, data used should help to identify the errors in the process and determine the root-causes. Data should then contain the information for example about the situation and product type when reworks occur. Then it should be possible to test theories of root causes for rework. Furthermore, the same principle of data is true with other measurements. (De Feo & Juran 2014.) De Feo & Juran (2014) state, that process adaptability cannot be measured.

Process measures should be strongly correlated with business performance measures. Furthermore, process owners must choose the measures which are linked to organization's business performance. (De Feo & Juran 2014.) When core processes are performing well, organization is also successful and achieves the desired goals. The perspective is changing from functional specialization to focusing on core processes. By improving them, organizational performance can be improved. According to De Feo and Juran (2014), process measurement is also part of process control. Process control is managerial process, where the actual performance is evaluated against the targets. Based on the evaluation, actions are taken to improve process performance. De Feo and Juran (2014) state that process owner and the process team evaluate the process performance and the process design itself in the reviews that process owner conducts. Business process management is based on the quality improvements from lessons learned. According to De Feo and Juran (2014), business process management also includes analyzing the process, redesigning the process, implementing redesign and managing the new process. In this thesis, the focus in on measuring the process. Other steps in business process management are out of scope in this thesis.

Rummler and Brache (2013) also see process management as improving performance while managing cross-functional processes. Rummler and Brache (2013, 3) criticize the vertical and functional view of an organization. Managers tend to also lead their organization vertically and functionally, which raises cross-functional issues. These are hard to manage as departments do not work together. (Rummler & Brache 2013, 4-5.) Furthermore, all departments have their own goals, which may not be consistent with organizational optimization. If for example R&D function is meeting its goals, but products don't sell, is the problem only then in the sales function? Or might the problem still be in the R&D function even though they are developing products on time and with reasonable costs? Rummler and Brache (2013, 6) introduce the horizontal view of the organization. This view shows the internal supplier and customer relationships. In addition, the view demonstrates, how processes are cross-functional.

Rummler and Brache (2013, 12-14) state that there are three levels of performance. These levels are organization, process, and job/performer. The levels are always connected to each other as the organization is a system. Goals, design, and management of these levels should always be aligned with each other and the strategy. According to Rummler and Brache (2013, 184), performance should be measured to monitor, control and improve the performance in different levels.

According to Rummler and Brache (2013, 185), organization should be managed as a system, when three matters must be considered. Firstly, the organization must have sound measures to monitor right effects. Secondly, the measurement system should be total rather than a collection of unrelated measures, which can lead to controversy and unwanted results. Thirdly, the information from measurement system should lead to actions managed by performance management process. (Rummler & Brache 2013, 185.) Rummler and Brache (2013, 185) list four steps, how to develop the measures for performance. They also state that the performance equals to the output. Measures should be developed to all three levels, which are organization, process and job or performer. For the scope of this thesis, we will only focus on the process level.

The first task is to identify the most important outputs of the process. The second task is to identify the critical dimensions of the identified outputs. Critical dimensions of performance can be divided into quality, productivity, and cost. Quality includes accuracy, ease

of use and repair, innovation, reliability, and appearance. Productivity includes quantity, rate and timeliness. Cost as a critical dimension includes labor, materials and overhead. The requirements of internal and external customers define the critical dimensions for the outputs. In addition, business' financial goals determine the critical dimensions. (Rummler & Brache 2013, 185.) The third task is to develop the measures based on the analysis of the outputs and critical dimensions. For example, if overhead has been identified as cost's critical dimension for the output, one or more measures should indicate how overheads are evolving. The final task is to develop goals or standards for the developed measures. A specific goal derives from performance expectations, which should get more ambitious, when performance continuously improves. (Rummler & Brache 2013, 185.)

Rummler and Brache (2013, 186) state that there are three important features in the earlier mentioned approach to develop performance measures. Firstly, measures are developed based on outputs rather than only implementing easy and contemporary measures. Secondly, the measures focus on customer as the outputs, critical dimensions and targets are based on customer needs. Finally, the measures imitate real life as they have more than one critical dimension. The new customer requirement is that companies' outputs can have for example both quality and cost, not only one dimension.

The measurement system should have links between all three level of performance. It's crucial that the needs of external customer and the business strategy are considered in the performance system of the organization. Furthermore, while evaluating process performance, the output of the process should be in line with the output of the organization. Rummler and Brache (2013, 187) divide measures into three different groups, which are M1, M2 and M3. M1 are used to measure end-to-end process performance and they can be either external or internal measures reflecting the needs of customers. M2 measures are linked to M1 measures as they measure the performance of subprocesses. M3 measures are used for performance measurement of process phases, which are critical for the performance of the process. These are only used with very critical phases as organizations should not have too many measures. (Rummler & Brache 2013, 191.)

According to Rummler and Brache (2013, 191), organizations' strategy and customer requirements define the measures. These measures give an opportunity to monitor process performance on the perspective of the wanted output of the organization. Furthermore,

measures highlight the critical phases of the process, which show is the process working properly. Without the measures for process performance, process owner cannot monitor the process and be updated, what is happening within the process.

Rummler and Brache (2013, 191) identify three types of measures, which are regular formal, regular informal and irregular measures. Regular formal measures are actual performance indicators, which are gathered regularly. For example, the measure can be monthly revenue for the sales entity. On the other hand, regular informal measures are periodically gathered information, which is not directly about performance. For example, sales representatives can keep record about the number of customer inquiries. (Rummler & Brache 2013, 191.) Irregular measures are used in unordinary situations to understand the causes for bad performance. Irregular measures are used for the time performance improves. All three types of measures are important for improving the performance of the process. (Rummler & Brache 2013, 194.)

Linking functions' goals with organizations' and processes' goals is important for overall performance. With process maps, it is easier to allocate measures and goals to different functions. If the process is more complex, the tool to use is responsibility matrix. With the responsibility matrix, there is no process phases which are forgotten because no function is responsible for them. The responsibility matrix is also useful as then process responsibilities are understood in the organization. (Rummler & Brache 2013, 194.) Responsibility matrix can also be in the third level, job/performer level, when every level of the organization work for the improving performance. (Rummler & Brache 2013, 200.)

As earlier stated, organizations' strategy and measures should be linked to the lowest level of performance, including process performance. Organization can develop performance logic to demonstrate the links between measures. The performance logic starts from the highest level and one to three measures are used to evaluate organization's performance. (Rummler & Brache 2013, 200.) For example, organization can use return on investment (ROI) or earnings before interest and taxes (EBIT) to indicate division performance. It's important to analyze the measure and determine which factors have effect on it. Furthermore, the variables that impact the measure, should be identified and quantified. In addition, we analyze the variables to see which factors impact on them and this procedure continues. In the end the organization have network of measures, which are related

to each other. For example, with EBIT, we can analyze revenue and costs. Then this goes on with different processes.

According to Rummler and Brache (2013, 204) measures are not often used in the optimal way. They should be used as the basis for the measurement system, which includes actions of gathering information, comparing the actual figures to the goals, and communicating the information effectively. Rummler and Brache (2013, 209) conclude that without measurement, performance cannot be managed and actions to improve performance are not taken as there is no clear causes for non-optimal performance. Furthermore, without measures, employees don't know, what is expected from them.

2.6 Summary of the theoretical framework

This chapter concludes the theoretical framework of this thesis. The offering development process is interesting process for the research as there are challenges in assessing the process performance. Performance measurement of processes combines many themes in the research field. In the management accounting literature, there has been need of studies about management innovations, such as quality management. However, in the management accounting literature, the quality and process management are not defined in an unequivocal manner. Usually different brand names are used in the literature. The objective of this chapter is to summarize the studies about the process performance measurement from the perspective of management accounting and process management.

According to Nixon (1998) research and development process is in the position, where the quicker results with higher efficiency are demanded. Furthermore, the evaluation of R&D process performance is difficult as the process involves cross-functional characteristics. New product development is important process for companies, as it can lead to competitive advantage and long-term success of organization (Nixon 1998; Taipaleenmäki 2014). Taipaleenmäki (2014) states that in many organizations management control systems are absent in the R&D process. However, management control systems have advantages in innovation processes and uncertain environments. R&D process faces internal and external uncertainties; therefore, management control systems can support

the R&D process. Management accounting tools are used in the process to increase the knowledge about for example costs. (Taipaleenmäki 2014.)

In the process and quality management, different brands have been popular in certain times. (For example, Jeston 2018; De Feo & Juran 2014) These different brands have been, for example, Business process Re-engineering (BPR), Total Quality Management (TQM), Six sigma and Lean six sigma. De Feo and Juran (2014) state that new brands are developed continuously to respond the needs for different organizations and environments. The evolution of process and quality thinking can be seen positive, continuous change. The brands emphasize different themes, but the basic idea behind the brands is the same according to De Feo and Juran (2014). The basis for the brands is in Juran's universals, which are planning, control and continuous improvement. These universals are based on the financial tasks, which are universal in different organizations. (De Feo & Juran 2014.) Therefore, the basic idea behind the process and quality management is natural for management accounting professionals. In management accounting literature different terms about process and quality management are used. For example, Lang-field-Smith (2007, 65) uses the construct operational strategies. In many articles, different brand names were also used, for example TQM on Hoque's article (2014). Furthermore, process and quality management are categorized as management philosophies. De Feo and Juran (2014) argue that it does not matter, what brand the organization is using, if the emphasis is on managing quality and processes. Managing processes involves different controls, which direct the employee behavior. Right controls can increase the employee empowerment.

Management control is defined as directing employee behavior by Malmi and Brown (2008). In the management accounting literature, there are different definitions about management control. Malmi and Brown (2008) state that management controls systems should be researched and evaluated as package, as different management controls are not working in isolation. Different management controls systems have impact on each other, and organizational context defines the success of management controls. The future research, especially case and field studies can be more accurate, if the context of organization is considered, while studying different innovations. In this thesis, the cybernetic controls in the framework of Malmi and Brown (2008) and results controls in the framework of Merchant and Van der Stede (2017) are important for developing measures for offering

development process. These controls with right combination of other management control systems can lead to employee empowerment. Cybernetic and result controls are sufficient especially for independent professionals. (Merchant & Van der Stede 2017, 34-35.) It is crucial to align measures with organization's strategy or the employees might behave in undesired way while achieving the measure targets. In addition, the financial goals should be translated to operational goals to communicate them effectively in different levels of organization (Merchant & Van der Stede 2017, 39-42.)

By using cybernetic and result controls, performance of the employees and the entire organization can be assessed better than only assessing financial figures. The study of performance measurement is not a coherent field of study as the researchers have very diverse backgrounds. The research has been done in the fields of accounting, information systems (IT), operations management and operations. (Neely 2005.) To make the topic even more complex, there are many different frameworks for measuring performance. According to Neely (2005), the most cited framework is Balanced scorecard (BSC). Furthermore, Rashid and Hossain (2020) state, that still after 15 years, BSC is the most popular and studied framework. Balanced scorecard is very popular in management accounting, which is confirmed by Bhimani et al. (2018, 636), when they use the framework to present how to measure quality in organizations. Measuring performance is not simple, as the choice of measures is crucial for the desired results, as Merchant and Van der Stede (2018, 42) state. In addition, the measures are not always directing the employee behavior to correct direction. Therefore, it is crucial that measures are precise, objective, time, understandable and cost efficient to avoid unwanted results. (Merchant & Van der Stede 2018, 43.)

De Feo and Juran (2014) state that measures are the basis for managing the process. Furthermore, measures should have good qualities as the measurement data should be base for the analysis. In optimal situation, data should help to identify root causes and therefore lead to the solution of problem and continuous improvements. Furthermore, the measures should be understandable for the analysis of root-causes. Both De Feo and Juran (2014), and Rummler and Brache (2013, 194) emphasize the importance of the process ownership. With functional goals and measures, the cross-functional issues increase. These issues are harder to observe and easy to forget if nobody is accountable for the results of the cross-functional process. The process owner can manage the process if the owner is

held accountable for the results. In the process management, the core processes and the measures are aligned with organization's strategy. (De Feo and Juran 2014; Rummler & Brache 2013, 185.) In addition, in performance measurement, frameworks emphasize linking the measures to strategy (For example, Taticchi et al. 2012; Hoque 2014). Both De Feo and Juran (2014) and Rummler & Brache (2013, 184) state that continuous improvements are crucial for managing processes.

The management philosophies also determine the management controls systems of the organization. In quality and process management, for example the cultural controls and organizational structure play key roles. The organizations' context determines the performance measures for organization or, in this thesis, process. Performance measurement is organization specific action and can only be assessed by knowing the context of the organization. The performance measures are based on organization's strategy and the control systems.

3 INTRODUCTION TO EMPIRICAL PART

3.1 Execution of the empirical part

The objective of this chapter is to provide detailed description of the use of methods to allow readers assess the reliability of this thesis. Firstly, in this chapter, the methods for gathering and analysing the research data are discussed. Secondly, the reliability of the thesis is assessed in the chapter 3.1.2. In addition, the actions taken to improve the reliability are described.

3.1.1 Gather and analysis of data

Data for the thesis was collected by interviews. In addition, company's documents were used as research data. According to Tuomi and Sarajärvi (2018, 62), research data can be gathered by doing interviews and surveys, observing, and collecting information from documents. These methods can be used in parallel based on the research issue and resources. According to Tuomi and Sarajärvi (2018, 72) documents used as research data can be divided into private documents and media products. The documents used in this thesis are private documents of the organization. The documents are cash flow and cost forecast of the products chosen to be analyzed in this thesis. The documents are standard documents, which are filled during the new product development products. In addition, the researcher has collected the actual figures to the calculations from different information systems, such as ERP. The document analysis is done to understand root causes behind the deviations in forecasted and actual performance. Recommendations for development of performance measures is based on the current measures in new product development process.

The simple idea behind interview and survey is that researcher will ask why or what person thinks. Tuomi and Sarajärvi (2018, 64) state that the difference between survey and interview is that researcher is acting differently in these methods. In interview, researcher is asking questions in person, whereas in survey informants fill the survey at home or in

monitored group situation. Interviews are flexible, which is a great advantage of the method. The researcher can repeat the questions, correct misunderstandings, clarify what is meant by question and have a conversation with the informant. Furthermore, researcher can ask the questions in the order, which the researchers finds the best for the situation. The key objective for interview is to gain as much information as possible about the research topic. In addition, interview is flexible as the researcher can observe the informant. (Tuomi & Sarajärvi 2018, 63.) The benefit of interviews is that researchers can decide, who to interview. Therefore, the informants know about the research topic. (Tuomi & Sarajärvi 2018, 64.) In this thesis, interviews are used to gain deep understanding about the research topic. The interviews deepen the understanding of the document analysis in this study.

Tuomi and Sarajärvi (2017, 64) categorize interviews into three different types, which are structured, semi-structured and unstructured. In the thesis, unstructured interview is used for gathering data. In this thesis, the consideration of interview was between semi-structured interview and unstructured interview. The difference between the interviews is not radical according to Tuomi and Sarajärvi (2018, 65). In semi-structured interview the researcher uses themes, which are decided beforehand and asks clarifying questions. The researcher can decide whether to ask same questions from everyone and how strictly the structure is followed. In unstructured interview only the discussed phenomenon is defined beforehand. (Tuomi & Sarajärvi 2018, 65.) In unstructured interview the discussion is related to the research topic and the researcher navigates the interview to keep discussion in the topic (Tuomi & Sarajärvi 2018, 66).

The difference between semi-structured and unstructured is in the interpretations of the researcher and interviewees. In the semi-structured interview, the researcher assumes that interviewees interpret the phenomenon in the same way as researcher and clarifying questions are not needed. In the unstructured interview, the interviewees answer how they interpret the phenomenon. (Tuomi & Sarajärvi 2018, 67.) In this thesis unstructured interviews were conducted as the interviewees have different backgrounds and they work in different positions. The interviews were directed to specific persons. In addition, most of the interviewees have engineering background and the researcher have accounting background. Therefore, interpretations about the same issues were different. Furthermore,

the researcher asked clarifying questions based on the answers. Researcher had few themes in interviews, but they were not strictly followed in order.

According to Tuomi and Sarajärvi (2018, 73), in qualitative research the number of interviews is not one of the most important considerations. More important is that the interpretations are sustainable and give deeper understanding about the research issue. The people, who are interviewed should know about the issue as much as possible and be experienced about the topic. In this thesis, the total number of interviews is nine. Two out of nine interviews were conducted as emails. Furthermore, more information was asked via email from different interviewees.

According to Tuomi and Sarajärvi (2018, 72), choosing persons to interviews must be based on the objectives of research and consideration of who knows the topic best. In this thesis seven different people were interviewed. For gaining the best possible understanding about the topic, the process owner, who is the vice president of R&D and product development, was interviewed three times. In this thesis the process owner, former project manager of the division X, two product managers and site controller were interviewed. The supply chain development specialist and NPD development engineer were interviewed by email. The people chosen to interviews have the best understanding about the issues related to their work and reporting in the offering development process and especially new product development process. Especially important for the interviews was to gain knowledge about the measure used in the NPD process. The quality of the interviews is increased by recording the interviews and transcribing them. In addition, the possibility for misinterpretations were decreased by conducting the interviews in Finnish, which is the native language for the all interviewees and researcher. The objective in translating the interviews was to maintain the content of the interviews similar in both languages.

According to Tuomi and Sarajärvi (2018, 78), in some extent content analysis can be defined as the loose theoretical framework of the analysis of data, which is either written, heard, or seen. The analysis of qualitative research can be divided into two separate groups. The other group of the analysis is navigated by theory or epistemology. On the other hand, the other group of analysis is not navigated by any theory or epistemology, but theoretical and epistemological frameworks can be applied in the analysis. Content

analysis is part of the latter analysis group. Tuomi and Sarajärvi (2018, 80) state that often qualitative research analysis is divided into inductive and deductive analysis. This distribution is based on the logic of thinking: inductive is from singular observation to generalization, whereas deductive is from generalization to singular instance. Scientifically this distribution is problematic as developing theory cannot be based on only observations. In addition, the distribution to inductive and deductive does not take abductive thinking into account. Abductive means that the formation of a theory is possible when there is leading thought while observing. (Tuomi & Sarajärvi 2018, 80.)

Content analysis can also be divided into data driven (*aineistolähtöinen*), theory connected (*teoriasidonnainen*) and theory driven (*teorialähtöinen*) analysis. The emphasis is on the theory or the importance of theoretical in the categorization. (Tuomi & Sarajärvi 2018, 80.) In this thesis contents analysis is defined as analysis, where documents are written. Content analysis can also be defined as analysis, where the contents of documents are quantified. Quantification can be used as a tool in content analysis. (Tuomi & Sarajärvi 2018, 89.) In this thesis data driven content analysis is used, which means that researcher's objective is to create theoretical complex from the research data. The key objective in data driven content analysis is that the units of analysis are not decided before the research. The earlier information and theory are not related to the results of the research. (Tuomi & Sarajärvi 2018, 80.) Yet, it is generally identified that there are no objective observations as the used constructs, research setting, and methodology are defined by the researcher and always have impact on the results (Tuomi & Sarajärvi 2018, 81).

According to Tuomi and Sarajärvi (2018, 91-92), the process of data driven content analysis contains three phases. First, the research data is reduced, which means that irrelevant information is eliminated from the research data. Secondly, the data is clustered, which means that similarities and differences are identified from data. Reduced expressions are categorized based on the phenomenon they describe. In this phase the basis for research and initial descriptions about the research topic are created. (Tuomi & Sarajärvi 2018, 93.) And finally, the data is conceptualized. In this phase the relevant information for the research is separated from the entire data. In conceptualization data is both divided and combined to sub-categories, categories, and themes. (Tuomi & Sarajärvi 2018, 93-93.) In this thesis the research data is reduced first. Then the different expressions are categorized based on the sub-categories they describe. Then the sub-categories are combined to

different categories. Finally, the categories are combined to different themes. In this thesis the themes are based on the context of offering development process, the current measures of NPD process and the measurement challenges of current measures. Finally, the conclusions are made how to develop qualities and data of NPD measures and how to develop measures, which indicate about the performance of the entire offering development process from the perspective of improving the gross profit of products. The analysis was navigated by conducted interviews and document analysis. First, the context of offering development process navigated the choice of analyzed measures and second, the analysis of measures navigated the analysis of measurement challenges.

3.1.2 Reliability of the thesis

Tuomi and Sarajärvi (2018, 119) state that the reliability of the research is usually assessed using the constructs validity and reliability. Validity means that the research and research objective are in line. Research is about the phenomenon it supposed to study. Furthermore, reliability describes how repeatable the results of the research are. The constructs validity and reliability are found to satisfy the needs of quantitative research. Furthermore, in quantitative research the constructs are based on the assumption about one concrete reality and objective information. Therefore, the constructs are criticized in the field on qualitative research. According to Tuomi and Sarajärvi (2018, 121-122), the research is always assessed as whole, therefore, the emphasis is on the coherency of the study. Researcher must give detailed descriptions of the gather and analysis of the research data to give readers the possibility to assess the reliability of the research (Tuomi & Sarajärvi 2018, 123).

As stated by Tuomi and Sarajärvi (2018, 121-122), reliability can be assessed using constructs credibility, transferability, and dependability. According to Tuomi and Sarajärvi (2018, 121), these constructs are based on the production of Guba and Lincoln in years 1981-1988. This reliability of this thesis is assessed using these three constructs about reliability.

The credibility is considered many ways in this thesis. The objective is to report the research data in detail. The documents used as research data are described in the results

chapter as detailed as possible considering the private and restricted nature of the documents. The reliability of the research data is assessed during the empirical results. Especially, when the researcher has gathered the actual numbers to the document analysis. The credibility in the research also assess the coherency of the research (Tuomi & Sarajärvi 2018, 122). In this thesis the empirical results are reported balanced way to consider the coherency of the study. Furthermore, the dialog between empirical results and theory in the discussions and conclusion chapter aim to ensure the coherency of the thesis. In addition, the credibility is ensured by using tables and figures of cash flow and cost calculation in the empirical part of the thesis.

The transferability considers the research's ability to lead generalizations in different contexts (Tuomi & Sarajärvi 2018, 121). The empirical research data consist the interviews conducted in the same division X. In addition, the research data documents are founded in this division X. Therefore, the results of this study are dependent on the certain context. In addition, the researcher makes always interpretations based on own values and earlier knowledge about the topic (Tuomi & Sarajärvi 2018, 19). The transferability of the research is considered in the thesis by describing the context in detail. Especially the management control system is described in the offering development process as the measures are context specific. Dependability means that researcher must consider factors, which are not forecasted in the beginning of the research. In addition, researcher must consider factors, which the phenomenon and the research itself cause. (Tuomi & Sarajärvi 2018, 121.) In this thesis dependability has been considered by following the general principles of conducting the research. In addition, the research situation and context has been described in detail in empirical part of the study and in conclusions.

3.2 Introduction to the research data

In this chapter, the research data is presented. The research data is based on case organization's documents and interviews about offering development measures. Therefore, first the case organization is introduced. Secondly, the interviewees are presented briefly. Finally, the analyzed documents of offering development process are going to be introduced. The research data includes information, which is potentially sensitive to the case

organization and the interviewees. Therefore, case organization and all interviewees are presented anonymously in this thesis. In addition, the presentation of documents in this thesis does not include any numerical data as it's sensitive information for the company. All numbers are presented as percentages. Furthermore, every product is presented anonymously in this report.

The case organization is the division X of the corporation, which headquarter locates in Sweden. The division X works globally but the products analyzed are manufactured in Finland. The corporation's turnover for 2020 was 10,6 billion dollars and the number of employees was 37 000 in 2020 (Orbis 2021). The division X is part of Finnish subsidiary, which works in industrial, electric, and electronic machinery industry. The turnover for Finnish subsidiary was 1.1 billion dollars and the numbers of employees was approximately 2000 in 2019 (Orbis 2021).

The persons chosen to be interviewed have knowledge about offering development process, new product development process, the reporting and documents related to processes. The objective was to gain deep understanding about the process and its performance. In this thesis the vice president of R&D, former project manager of the division X, two product managers and site controller were interviewed. The supply chain development specialist and NPD development engineer were interviewed by email. The vice president of the R&D is also process owner for the core process of offering development process. He has the knowledge about the whole offering development process; therefore he was interviewed three times as earlier mentioned. The former project manager has the knowledge about the new product development projects and all reporting and documentation related to it. In addition, product managers have knowledge about their own products and the gross profit of the products. They consolidate the cash flow forecast documents during the NPD project. Product manager A has the knowledge about products Y and X and product manager B knows about product Z. The site controller was interviewed as the controller has the knowledge about the actual reporting about the costs of products. Supply chain development specialist has the knowledge about, how the actual labor hours are reported in the assembly. Furthermore, NPD development engineer knows how the forecasted labor hours are calculated to the cost forecast document.

In this thesis the cash flow forecast of pay-off calculation and the cost-follow up documents are analysed. These are two documents for the new product, which are updated regularly in the different stages of the process. Pay-off calculation for the product is made by the product manager and approved by the business controller. According to process owner of offering development, product managers are consolidating the information from different sources to the pay-off calculation. Data and the information are based on the estimates, for example, about labour hours from the production and about the volumes from the front line. The other document, cost follow up, is based on estimates from different streams or supporting functions. The documents analysis will give deeper understanding, which estimates include inaccurate information. In addition, the root cause analysis is conducted based on the document analysis. The actual figures come from company's different information systems.

4 EMPIRICAL RESULTS

4.1 The context of offering development process

Table 1 presents the context of offering development in case division based on the interviews. The context is described in detailed as for developing and examining the measures, the context cannot be separated from the findings. This is emphasized in the literature about management control systems in the chapter 2. The importance of new product development (NPD) process and challenges in current NPD process measurement in the total offering development process were emphasized in the interviews. In this thesis, the results are presented starting from the context to ending to detailed findings. In this chapter 4.1, the context of the division and the offering development process is described.

Table 1 The context of offering development in case division X

Reduced expression	Sub-category	Category	Theme
Engineers work long period with the project	Nature of NPD process	The importance of NPD process in offering development process	The context of offering development process in case division X (chapter 4.1)
NPD project is continuously evaluated			
NPD process is gross-functional process	Cross-functionality in streams		
Improving gross profit is cross-functional process			
The products have not reached the estimates	Views about current performance	Challenges in current process measurement	
Time to market has been priority			
Backgrounds of the projects are crucial to understand when evaluating projects			
Post evaluation of products needs attention			
Measures are used for forecasting purposes	Current measures		
Unawareness of whether the measures are calculated correctly			

Organization structure for division X has been changed from functional to process organization within a year. Processes are viewed as streams and the organization has been structured to support process thinking in the organization. Offering development stream

is one of the four core processes of the organization. Furthermore, other core processes are streams of sales and marketing, supply chain and aftermarket. The division X emphasizes quality and continuous improvement in their communication to the employees. Also, the management team highlights the ownership of own work. This can be seen in Townhall meetings, which are organized four times a year to communicate about quarters' performance, developments, and future events.

In the division X, offering development process is well documented and easily available for everyone involved in the process. Offering development contains prospecting and planning, new product pre-concepting, new product development and current product development. The former project manager states that NPD project is the "speedup" of the offering development process. The new product development contains five gate phases, where the performance of the new product development is evaluated. These are important to assess the project and the progress. These gates are zero to five (G0-G5) and the post evaluation of the product lasting approximately one to two years after launching. In this thesis, only gates two and four are introduced in further detail. In addition, the post evaluation in this thesis is done using the data from the systems collected by the researcher. The former project manager states that the post evaluation has not yet reached its best potential. According to project manager, it is worth to notice that engineers work for a long while with the same project. Therefore, it is hard to back off from the project and assess it objectively.

The strategy of the division X sets the basis for offering development process measures. Improving gross profit is important initiative in the strategy. Therefore, developing process measures is based on improving gross profit from the perspective of offering development process. Furthermore, in offering development process improving gross profit means that the gross profit of products must be improved already in the development phase. The director of R&D, who is the owner of the process, states that gross profit is impacted also by other processes than only offering development process. The process owner state that new product development, NPD, is very critical process in the total offering development process. Furthermore, NPD process occurs cross different streams. Therefore, the streams are working as network. In the process management literature, cross-functional processes are described as the hardest to manage, which is based on the nature of the process.

According to process owner, estimating especially the success of new products has failed in recent years in the division X. There are different controls and measures, but still the actual price, volumes and costs have not met the actuals. Along with process owner, time to market has been given high priority in the division X. The division can either accept the costs and launch the product quickly or launch the product later and work with manufacturing costs before launching. The background of the projects should be known, which was stated by both the process owner and former project manager. In some cases, there is lack of resources or the environmental uncertainty has impact on the decisions. For example, COVID-19 affected the decisions made and the resources available.

As stated, there are controls and measures in the offering development process in division X. The measures indicate that estimated and desired performance has not been always achieved in product development. The measures are used to indicate the performance of the product. Process owner argues that it is crucial to understand, why the targets have not been achieved and what are the root causes for it. The process owner states that it is also important to understand if the division is good at forecasting the need for offering. The cash flow and product cost forecast can be used as measures, when compared to the actual performance. It is worth of investigating can these measures be developed to attain better performance in the entire offering development process. Furthermore, the measures and actual numbers can be calculated based on different assumptions, which must be investigated. Process owner states that the history is not important to assess itself, but we can learn about the processes and continuously improve them.

4.2 Measures of New Product Development

The case company's offering development process struggles to forecast the gross profit for new products. The objective is to study, why the estimates differ from actual performance of the new product. The process owner and the researcher have identified three important stages in offering development process, which are stages of establishing project plan, getting sales permission and post evaluation of products. The organization uses gate model, and these are gates 2 and 4. In addition, there is post evaluation, where in this

thesis the actual performance currently is evaluated against forecasted performance. By analyzing these stages and the controls related to them, it can be defined, what measures to use when evaluating performance of offering development and furthermore, how to improve the gross profit forecast for new products.

The table 2 contains findings about current measures of new product development based on the analysis of the documents and interviews. Firstly, the estimated performance in cash flow forecast is better than the actual performance. Secondly, the forecasted costs are estimated to be lower than actual costs. Categories are divided in sub-categories, which explain the deviations in calculation components. First in this chapter 4.2, the cash flow forecast, and the cost forecast are introduced in further detail than in the chapter 3. Secondly, the cash flow forecast is analyzed using tables to demonstrate the deviations between different forecasting stages and actual numbers. Thirdly, the forecasted costs are analyzed using figures to show bridge between forecasted manufacturing cost and actual manufacturing cost. Choice of current NPD measures for analysis are based on the findings about the offering development context.

Table 2 Current NPD measures

Reduced expression	Sub-category	Category	Theme
Is there any product which can be used for comparison	Lower volume than expected	The estimated performance in cash flow forecast is better than actual performance	Current NPD measures (chapter 4.2)
Different sales areas make the estimations			
Delay with volumes			
Higher costs than estimated	The gross profit is lower than expected		
The price set does not cover the increase of costs			
Estimated material costs are lower than actual costs in every analyzed product	Material costs are higher than estimated	The forecasted costs are estimated to be lower than actual costs	
Material costs are the largest cost component of one product			
Labor hours are higher than expected	Work-related costs are higher than forecasted		
Overhead costs are higher than expected in every product			
Increase of labor hours can have double impact with overhead costs			

For the analysis of the documents, project documents of product Z, Y and X are chosen for further investigation based on the interviews with the process owner. The products are manufactured based on customer order and therefore, they are highly customized products. Products Y, Z and X have been launched in recent years and they have good coverage of documentation. In addition, these three products are mature as they have been launched over two years ago. The newer products would not be mature for the research. Furthermore, the estimates for products Z and Y were not successful, which will be emphasized further in the research. The forecast for product X was more consistent with the estimates, but the analysis reveals that there are measurement issues in forecasting process. Prices, volumes, and costs will be analyzed to gain understanding about how to develop measures for the offering development performance. The two documents analyzed are cash flow forecast and cost forecast for the product. They were introduced in chapter 3.2.

One part of pay off calculation is cash flow forecast for the new product. In the thesis the analysis has been conducted by analyzing the cash flow forecast to the actual figures. Cash flow forecast is done by forecasting cash flows to upcoming years after the product has been launched. The cash flow forecast calculations include volume, price, cost, monetary value of gross profit and gross profit percentage for one unit of product. Furthermore, the forecast includes annual revenue and gross profit in monetary value and as percentage. In addition, the cash flow forecast includes aftermarket gross profit, but that is out of this thesis' scope. Volume forecast is estimated based on the forecasts from frontline. Product manager is working closely with sales area business line managers and backline sales management. According to product manager A, volume estimates can differ a lot depending on sales area. Business line managers differ from their background and experience. In addition, product managers and sales managers in backline know the technical specifications of the product better. Therefore, they are obligated to update the forecasts, which frontline prepares. The actual volumes are based on sold products in 2020.

According to product managers, price is estimated customer price with average options. In practice, there is basic unit and the customer chooses the options of their own choice. Therefore, customer can choose extensive, medium, or low number of options. Product manager and sales managers with business line managers of the intended markets, will

estimate the average options. For different sales areas, the average options are different. Therefore, average options are estimated based on the estimated volumes. There are number of different options, which can be either large or small. For example, large or complex option systems must be possibly assembled in the beginning of the production to the product. Simple options can be inserted more easily. Options determine a big share of the customer price. Average options are determined with the main market areas of the product. In practice, products are not sold without options. According to product manager B, competitor's price of similar product has impact on setting product price. The actual price in the analysis is the average of all products sold in 2020. Options are not possible to separate from the price without using assumptions. In addition, cash flow forecast includes total price with options. The products have different level modifications, but this has not been considered in the calculation of actual numbers. The purpose of this analysis is to make root-causes for deviations visible.

The costs of product are determined based on cost calculation. The total cost is the sum of manufacturing cost, the cost of average options and sales company costs for product, such as freight. Manufacturing costs are evaluated without options, even though customers do not order products without options as earlier stated. Furthermore, in practice options' material or labor costs are not separated from total material or labor costs in actual numbers. Therefore, the forecasting is more challenging. The actual cost is calculated as an average from the total costs of products sold in 2020. In the cash flow forecast only the total costs are used. In cost calculation for product options costs have been estimated based on the standard option costs forecasted for the products. The total cost is average of actual costs, but separation is based on estimate that 80 % of options costs are material costs, 10 % labor costs and 10 % overhead costs. In addition, the average option costs have been calculated based on the products sold in 2020.

Gross profit monetary value and percentage are calculated by using estimated price and costs in the cash flow forecast. Furthermore, the actual figures are calculated by using the same principle. The annual figures are calculated only adding the volume to the calculations. The actual figures are calculated using total actual revenue and gross profit of the products. In the actual figures, product revenues have first been transformed to Swedish krone and then to euro, which can cause small deviations to figures. Costs have been calculated only in euros, as euros are used in factory's own reporting.

In this the analysis is conducted by comparing cash flow estimates at one year, 2020, to the actual numbers in 2020. Cash flow forecasted includes the worst-case scenarios, the best-case scenarios, and the expected scenario, which is in the middle of the worst and best case. In the tables 3, 4 and 5, the percentages in gates two and four are from worst-case scenario to the best-case scenario, except in cost, where they are from best-case scenario to the worst. Hundred per cent is the expected outcome in gate four for every row. For example, the actual volume is expressed as percentage of expected value in gate 4. The same principle works with other rows and furthermore, with the cash flow forecast tables of all three products.

According to product manager B, the development of new product is depending on the product's market. Product Y was developed for new market segment. According to product manager A, product's features were prioritized highest in the NPD project. However, product manager A states that cost calculation of product was naturally monitored during the NPD project. Table 3 shows that in gate two the estimated volume was approximately 40 percentage points lower than in gate four. The reason behind this is that management team of that time asked to increase the estimated volume in cash flow calculation. The actual volume was 39 percentage points lower than the worst-case scenario in gate four. The table 1 shows, how the estimate in gate 2 was closer to actual than in the gate four. Furthermore, product manager A states that in year 2021 the volumes are close to estimated, which is proven by order intake for the year. There was only delay with the volumes. The price was evaluated to be slightly lower in gate two than in gate four. According to product manager A, price and costs from options were estimated more accurately for different main sales areas after gate two, which increased the estimated costs and price. The actual price is 27 percentage points higher than what was estimated in the best-case scenario in gate four, when the permission for sales is given. The increased price might be result of increased costs as the standard prices are set higher than what was estimated. In addition, there might be more options in products in average what was forecasted, therefore they are valued more. Further, the cost calculations are analyzed in more detail. Furthermore, the price is not only based on costs as the market has impact on price. In addition, for example, bundle deals with customers can lower the average price of products. (Table 3.)

Table 3 Cash flow calculation for product Y

Year 2020	Product Y		
	Gate 2	Gate 4	Actual
Volume	48-59%	80-108%	41%
Price	85-104%	90-110%	137%
Cost	89-98%	97-107%	147%
Gross profit	61-130%	60-133%	121%
Gross Profit %	71-125%	67-119%	89%
Annual Revenue	41-61%	72-119%	57%
Annual gross profit	29-76%	48-144%	42%
Annual gross profit %	71-125%	67-119%	74%

Table 3 shows that the cost was forecasted to be lower in gate two than in gate four. As mentioned earlier, the average of options was increased in calculations after gate two, which has impact on total cost estimate. Actual cost for one product is 40 percentage points higher than what was forecasted for worst-case scenario in gate four (Table 3). The forecasted manufacturing cost were estimated to be lower. In addition, the products have more options in average than what was estimated in gate four. Therefore, the costs of options are also higher. (Table 3.) Manufacturing cost will be analyzed later in this chapter. Monetary value of one product's gross profit was in line in gate two and four. Actual gross profit for one product Y was in the estimated scope of gate four. The actual figure was between estimated and best-case scenario. However, the gross profit percentage for product Y was lower as the product was manufactured with higher costs, but the price did not increase as much as costs. Annual revenue and gross profit indicate the lower actual volume than forecasted in gate four. However, the annual gross profit percentage of product Y was in the estimated scope as in general, the products were sold in estimated profit margin. (Table 3.)

There were already three products from the division X in the market segment of product Z. In gate 2, volume was estimated to be higher than in gate 4 (Table 4). The actual volume for 2020 was 50 percentage points lower than what was expected in gate 4 in worst case scenario. Product manager states that there have been quality challenges with the product Z, which have impact on the volumes of the product. According to product manager B, price for product was set based on the competitor's product in the main market. The unit price was estimated to stay similar in gates two and four. The actual price increased four percentage points from the best-case scenario in gate 4. However, the cost

of one unit increased 16 percentage points from gate 4 worst-case scenario. Furthermore, gross profit of one unit is in the expected scope, eight percentage points under expected value. In addition, gross profit percentage was in the scope, but 20 percentage points under the expected value. Cost, gross profit and gross profit percentage were in line in gate two and gate four. Annual revenue, gross profit and gross profit percentage were estimated to be higher in gate two than gate four due to volume decrease in gate four. Actual annual revenue was 38 percentage points lower than worst-case scenario in the forecasted cash flow document. This was due to volume decrease, even though the price was higher than in the estimates. Actual annual gross profit dropped by 22 percentage points and gross profit percentage by 20 percentage points from estimates. (Table 4.)

Table 4 Cash flow calculation for product Z

	Product Z		
Year 2020	Gate 2	Gate 4	Actual
Volume	89-122%	80-110%	30%
Price	89-108%	90-110%	114%
Cost	93-103%	97-107%	123%
Gross profit	54-143%	50-141%	92%
Gross Profit %	60-130%	57-127%	80%
Annual Revenue	79-132%	72-121%	34%
Annual gross profit	48-174%	40-155%	18%
Annual gross profit %	60-130%	57-127%	37%

According to product manager A, the product X was developed based on two already existing products. The product's features are mix of these two products. There was a demand for the product X as the product was designed for customers, who want a product, which is somewhere in the middle of the two existing products. Table 5 shows the volume for product X was estimated to be slightly lower in gate two than in gate four. The actual volume is in the scope of forecasted volume in gate four. Reason for the accuracy can be well-known main markets for product X. As earlier stated, there were already two products in the market. The price is also slightly lower in gate two than in gate four. The actual price is 12 percentage points higher than what was estimated in the best-case scenario in gate four. As earlier stated, this can also be caused by higher average options than forecasted. According to product manager A, the price was estimated based on the prices of existing products. Furthermore, the target cost was set based on the estimate of price. The cost for one product was 3 percentage points lower in gate two worst-case scenario than

in gate four best-case scenario. According to product manager A, the manufacturing costs caused the increase in the costs. Manufacturing costs increased as material costs increased, which was caused by human error. The actual costs were 13 percentage points higher than what was estimated in the worst-case scenario in gate four. As earlier stated, the difference is caused either manufacturing cost or average option cost. The difference will be analyzed later. The actual gross profit for the product was in the scope, being two percentage points from best-case scenario in gate four. Gross profit percentage for the product was also in the scope. Annual revenue, monetary gross profit for sold products and gross profit percentage of annual product X sales were in the scope, what was forecasted. (Table 5.) Overall, the cash flow forecast for product X was close to the actual.

Table 5 Cash flow calculation for product X

	Product X		
Year 2020	Gate 2	Gate 4	Actual
Volume	61-87%	78-117%	87%
Price	85-106%	89-111%	123%
Cost	88-94%	97-103%	115%
Gross profit	62-153%	53-147%	145%
Gross Profit %	75-146%	61-132%	118%
Annual Revenue	52-93%	70-131%	107%
Annual gross profit	38-133%	41-173%	108%
Annual gross profit %	75-146%	61-132%	104%

Table 6 summarizes the actual cash flow of products related to forecasted cash flow. In this table 100 percentage is again the expected value in gate four, when the product is permitted for sale. Table 6 indicates that product Y has not reached the targeted volume and product gross profit percentage level. Therefore, the annual cash flow of the product is weaker than expected. With product Z, the same trend can be seen. The table 6 shows how the product X is performed as expected or even better than expected in best-case scenario. In the cash flow calculation, the largest negative deviation between forecast and actual is in the volume. The volume has large impact on annual cash flow calculation and therefore, the annual performance is below the estimated. Largest deviation in the unit calculation is in the unit cost, which also has impact on gross profit. In every product the cost is either as expected (Product X) or above expected (Products Y and Z). In any product, the unit costs are not below the expected cost. (Table 6.) When setting the unit price, unit costs are not the only consideration as the price is reflecting the market. However,

costs have impact on price. If the price increases, the volume decreases. And if the volume decreases, the costs will increase as the component batches are smaller. This shows how every part of the calculation is connected to each other. Next, the unit costs of the products X, Y and Z are analyzed.

Table 6 Consolidated cash flow calculation for products Y, Z and X

				Expected			
	<40%	40-60%	60-80%	80-99%	100-120%	120-140%	>140%
Volume	Z	Y		X			
Unit price					Z	Y,X	
Unit cost					X	Z	Y
Unit gross Profit				Z		Y	X
Unit gross Profit %				Z,Y	X		
Annual Revenue	Z	Y			X		
Annual gross profit	Z	Y			X		
Annual gross profit %	Z		Y		X		

Cost calculations are assessed in every five gates of the NPD project and in post evaluation stage. The calculations include manufacturing cost, options costs, sales company costs and the customer price. Furthermore, the gross profit for the product is calculated for the factory, sales company and consolidated gross profit for division. First, we will analyze manufacturing costs, which include material costs, labor and subcontracting costs, overhead costs, warranty costs and other costs. Manufacturing cost consist mainly material costs (70-80 %), labor or subcontracting costs (10-15%) and overhead costs (10-15 %). Warranty and other costs are only few percentages of total manufacturing costs. In this thesis the deviation between gate four forecast to the actual performance is analyzed.

The actual cost and price data for analysis is from company X's enterprise planning systems. The actual costs are calculated as an average from all sold products in 2020. The costs analysis could have been done by analyzing actual costs and the price of one unit of product. Either the median or the unit of product with lowest option level could have been chosen. Then analysis would have shown only issues with that specific product, possibly excluding general issues. Therefore, products are analyzed as an average and average options are reduced from the average costs using following principle: material costs include 80 percent of option costs, labor or subcontracting I include ten percent and

overhead costs also ten percent. Furthermore, options costs are estimated as standard costs as we cannot separate actual option costs from the total manufacturing costs. The assumptions behind the calculation have impact on results, but the purpose of the analysis is to find causes for deviations between actual and forecasted performance of the product and process.

In addition, the products have different levels, but in this thesis, they are categorized only as one product as the cash flow forecast and cost calculation is also calculated by the assumption that the calculation is about one product. As earlier stated, every product is different as they are customized based on orders. The analysis is done following the same principles as the forecasted calculation. The warranty costs are excluded from the actual costs as the products sold in 2020 have warranty left, when the thesis is written. Therefore, warranty costs cannot be reliably allocated to specific products, and warranty costs of these units can rise in the future. The analysis is based on the actual data division X has when the unit of product is sold. As figures 1, 2 and 3 show warranty costs are only 2 percent of forecasted manufacturing costs. Therefore, warranty costs are not in the scope of the thesis. Warranty is in the figures 1, 2 and 3 to demonstrate the gap between forecasted and actual.

In the figures 1, 2 and 3, the analysis of cost calculation is made based on differences between gate four numbers and actual numbers of products without options. Options are excluded as the cost calculation excludes them as well, only calculating manufacturing cost without options and adding them in the total cost. All actual costs are compared to the same costs in gate four. Furthermore, the deviations are compared against the total manufacturing costs in gate four. For example, actual material costs are compared against material costs in gate four producing the percentage. The difference between the costs is then divided with the total manufacturing cost in gate four. In figures 1, 2 and 3, *total cost in G4* is the total manufacturing cost in gate four and *Actual total costs* is the actual total manufacturing costs.

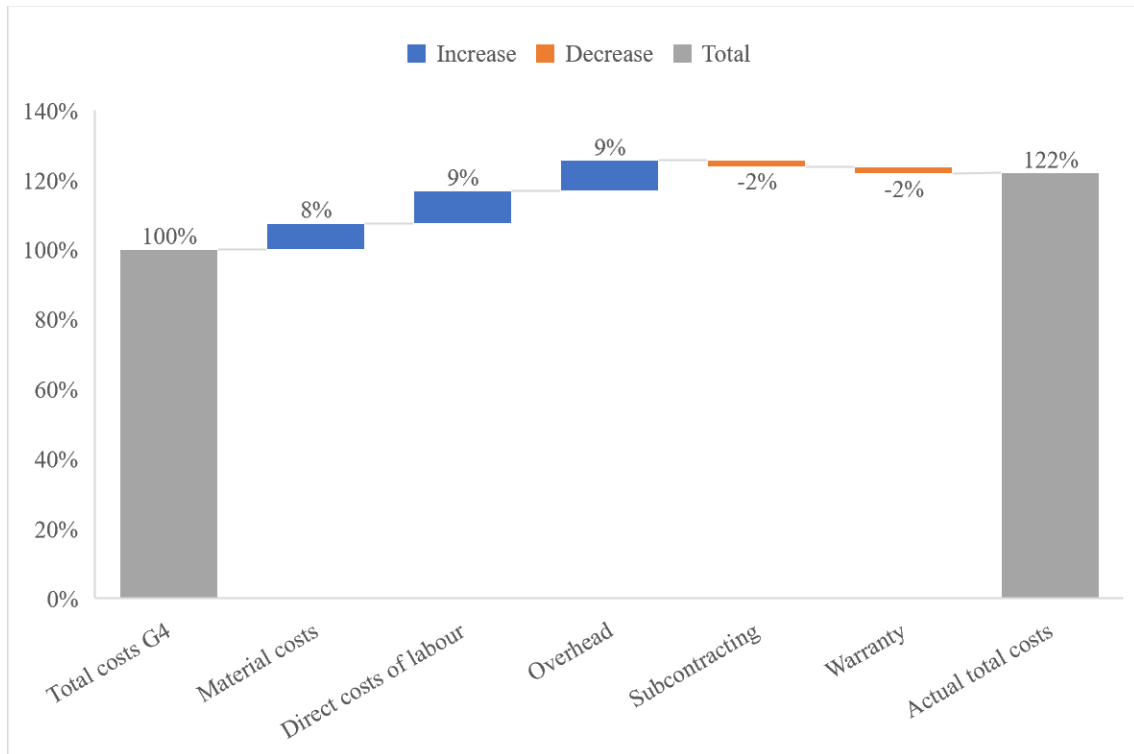


Figure 1 The manufacturing cost bridge for product Y

The product Y was designed for new segment and the focus was to design product with all the needed features. In figure 1, total manufacturing cost in gate four is presented as hundred percent. The actual total manufacturing costs are 22 percentage points higher than what was estimated in gate four. Material costs, direct cost of labor and manufacturing overhead costs were the most significant factors for the deviation with product Y. The actual material costs were 9 percent higher than estimated in gate four, which explains 8 percentage points of the deviation between the actual and gate four. With product Y, material costs are about 72 percent from total manufacturing costs. The actual direct cost of labor is 171 percent higher than estimated in gate four. It explains nine percentage points of the deviation in manufacturing costs. Overhead costs are calculated based on the labor hours. Therefore, when the labor hour estimate was much lower than the actual labor hours, the overhead costs were higher than estimated. The 134 percent higher overhead costs explain nine percentage points of the deviation between actual and estimated total manufacturing costs. Subcontracting was forecasted to be 48 percent higher than it was. In the analysis it only explains two percentage of the deviation. Warranty costs are excluded from the analysis. Therefore, they explain two percentage points of the deviation. (Figure 1.)

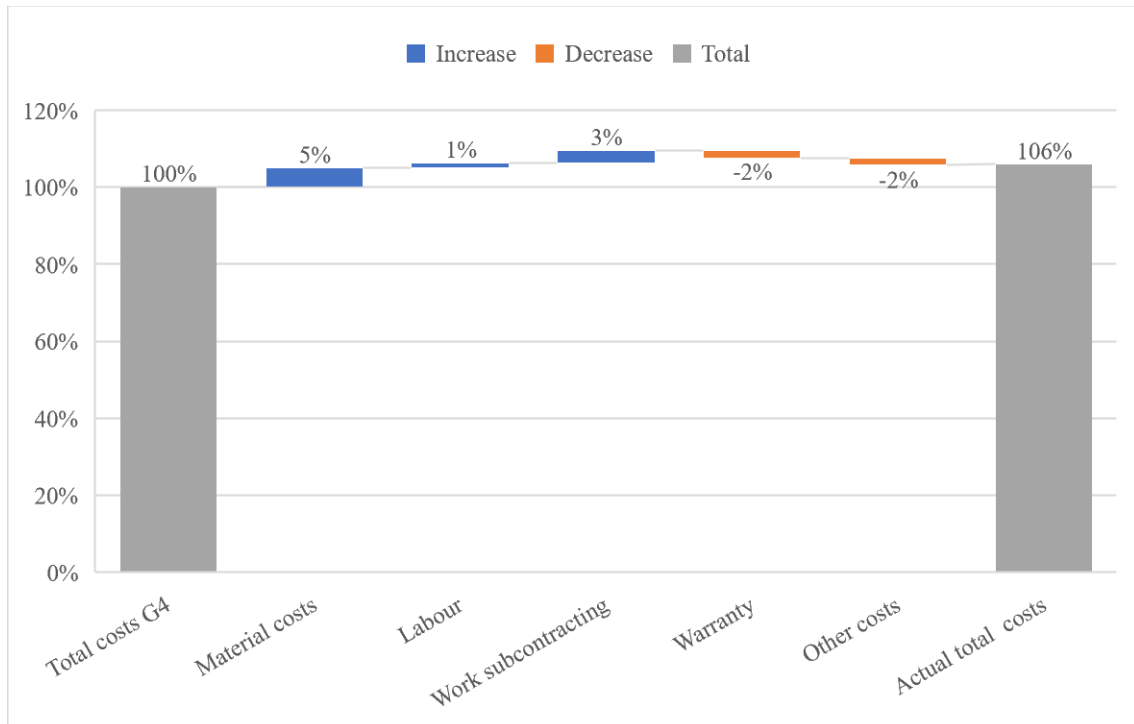


Figure 2 The manufacturing cost bridge for product Z

Product Z was developed to the same segment, where there were already three products. Figure 2 shows that actual manufacturing costs are six percentage points higher than estimated in gate four. As with product Y, material costs and work costs explain the deviation between actual and forecasted total manufacturing costs of product Z. Actual material costs are seven percent higher than forecasted, which explains five percentage points of the deviation between forecasted and actual manufacturing costs. (Figure 2.) Actual direct labor costs are 19 percent higher than forecasted, which explains only one percentage point in the bridge. Subcontracting costs were estimated to be zero in the gate four. However, actual subcontracting costs were 50 percent of estimated direct cost of labor. The increased subcontracting costs explain three percentage points of the deviation of actual and forecasted costs. Therefore, work costs explain four percentage points of the deviation. (Figure 2.) It is worth mentioning that option costs are excluded from the manufacturing costs based on the principles earlier mentioned. Warranty is excluded from the analysis, which means the deviation between actual and forecasted costs is larger than demonstrated here.

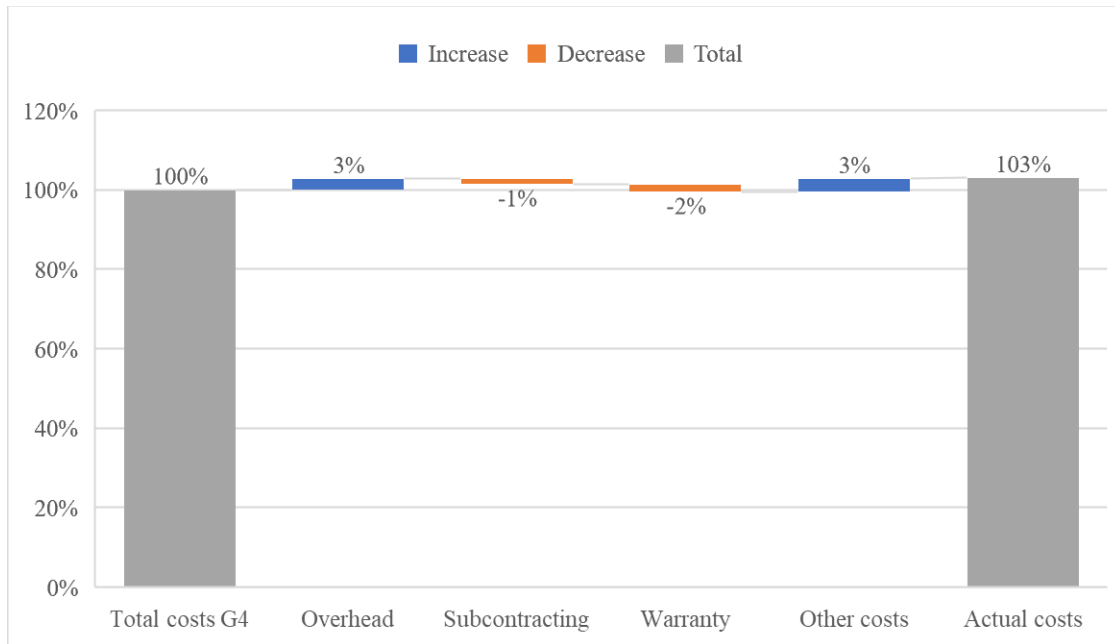


Figure 3 The manufacturing cost bridge for product X

The price and costs for product X were forecasted based on the similar products in the same segment. According to product manager A, especially material costs were followed closely during the project. Compared to product Y and Z, product X is smaller, have smaller costs and is sold with lower price. As figure 3 shows the actual manufacturing costs without options are three percentage points higher than forecasted in gate four. Any deviation between actual and forecasted is not large considering the size of the product. Overhead costs are 67 percent higher than estimated in the gate four. The difference between the numbers explains three percentage points of the deviation. (Figure 3.) The difference is due to the assumptions behind the forecast calculation and the actual costs. The work-related costs are analyzed further in the thesis.

The deviations in the manufacturing costs were analyzed using the cost calculation forecast and the actual costs. The two most important factors in the product cost are material and work costs. Every deviation in the material costs have impact on manufacturing costs as material costs form the largest share of product costs. Especially with product Y, the difference between work related costs forms the large share of the total deviation in 2020. Furthermore, the difference between forecasted and actual labor hours leads to increase in overhead costs as they are calculated based on labor hours. Therefore, the estimates have larger impact than only on labor costs. The difference between estimated and actual total costs were larger than when comparing only manufacturing costs. For example, the

total cost of product Y was 45 percentage points higher than the estimated. Manufacturing costs were 22 percentage points higher than estimated. Therefore, the average option costs are lower in the estimates than in actual numbers.

4.3 Measurement challenges in offering development process

Table 7 Measurement challenges in offering development process

Reduced expression	Sub-category	Category	Theme
Component costs are missing from actual costs	The actual material costs are inaccurate	The actual and forecasted material costs are not reliable (chapter 4.3.2)	Measurement challenges in offering development process (chapter 4.3)
Dissatisfaction with material cost data			
The latest acquisition price is not used in estimates	Estimates are lower than actual material costs		
Estimates are calculated by using average stock value of component			
Estimates are prone to human errors			
Estimating labor hours bases material estimates	Estimating labor hours in NPD process	Measurement issues in work-related costs (chapter 4.3.2)	
The goal for estimating labor hours is coordination			
Ramp up is important for forecasting the hours			
All hours, assemblers are reported to be working with the product are reported as product costs	Defining actual labor hours		
In assembly, earlier issues in process will realize			
Allocated based on the forecasted volumes for similar products	Measuring overhead costs		
Forecasted overhead costs are based on different assumption than actual overhead costs			
In the ERP system, option costs cannot be separated from total cost	Currently actual option costs cannot be analyzed	Measurement issues in option costs and pricing (chapter 4.3.3)	
Options are hard to define as they can be systems			
Options cause deviations in forecasts			
Setting the costs is manual process	Setting option cost requires time and resources		
Setting option costs is prone to errors			
Support from supply and finance is needed			

Table 7 presents the findings about measurement challenges in offering development process based on the analysis of documents and interviews. The findings of the analysis of cash flow forecast and cost forecast in chapter 4.2 are basis for the chapter 4.3. There are measurement challenges in both forecasted and actual material costs, work-related costs and option costs as the assumptions behind different calculations are not the same. (Table 7.) The deviations in material costs, work-related costs and option costs are analyzed in this chapter in further details. The root causes for deviations are analyzed to provide information for improving the measurement data and for developing the process measures in the future.

4.3.1 Material costs

The material costs are 70 to 80 percent of total cost of product. Deviations in material costs have large impact on total cost of the product and therefore, the gross margin of the product. The actual material costs for product are calculated using resource planning system. Every component is reported to the product unit. The value of the component is calculated using the average value of the specific component, not for example the latest acquisition price. However, the increase in prices should be considered in the forecasts for material costs and therefore, the acquisition cost should be used. Especially, if the component prices are increasing. The component stock average also increases, which should be considered as it is used for actual costs. The material costs are calculated for the future therefore, estimates should be best-guess or even conservative. If the price of component change, and the component price forms the large share of the material cost, the forecasted total material costs and actual costs will have large deviation. Especially if there are cumulative changes from many components.

Material costs are calculated by the sourcing team of the division. Now the actual material costs are not accurate. According to product manager B, even some larger and expensive components are missing from the ERP-system. Therefore, the actual material costs might be even higher than the system's data states. There is ongoing project and thesis, which objectives is to solve the issue. Further analysis of material costs is not in the scope of this thesis. Now, product managers are not satisfied with the data and inaccurate data leads to frustration. Especially, when evaluation of costs and product's performance is

done much later than the calculations. In addition, with the product X, few components were missing from the calculation in the beginning of the project due to human error.

4.3.2 Work-related costs

Table 8 shows total labor hours of gate four as a 100 percent. In the cost calculation, assembly hours are always calculated without options. The actual labor hours without options are based on the assumption that 10 percentage of option costs is labor, and the hour rate is the same. In products Z and X, total manufacturing hours for one unit of product was estimated to be higher in gate 2 than in gate four. Products Y's labor hours were assumed to be 20 percentage points lower in gate two than in gate four. The actual total labor hours without options were 110 percentage points higher than in gate four for product Y. For product Z, the actual total labor hours were 42 percentage points higher than estimated in gate four. Only for product X, the actual total labor hours without options were lower than estimated. Furthermore, the actual total labor hours were 13 percentage points lower than forecasted in gate four. For product Y, there is increase of 30 percentage points in assembly hours with options. In addition, for product Z, the increase is 38 percentage points and for product X it is 22 percentage points. The labor hours for options are based on the cost of options, which possibly are not up to date (Table 8.)

As table 8 shows, the own labor and subcontracting differs in different gates with products Y, Z and X. With product Y, in gate 2 there were no forecasted subcontracting. In gate 4 subcontracting was 28 percent of the total labor hours. Actual subcontracting hours decreased from gate 4. For product Z, in gate 2 subcontracting hours were forecasted, but in gate 4 there were no subcontracting hours. Actual subcontracting hours were 5 percentage points higher than estimated in gate two and 23 percentage points higher than in gate four. With product X, in the gate 2, product was estimated to be manufactured mainly in the own factory. In gate four the product X, was planned to be subcontracted. If we compare the actual subcontracting hours without options and the forecast in gate four, the actual hours are even lower. It must be remembered that in practice there is no products without options, but for the basic unit labor hours are estimated without options.

According to NPD development engineer, subcontracting hours are estimated based on the offer from the subcontractor. Usually, the offers are asked from the subcontractors, who already make the similar modules. According to the NPD development engineer, due to lack of resources, following and bidding the prices can be defective. If the person, who asks the offer is not experienced, the price is not optimal. Furthermore, the subcontractor offers the price based on their own view and experiences from earlier modules. When analyzing the costs of subcontracting, it should be mentioned that in some cases both actual material and labor costs are reported to subcontracting. It depends on whether the division X owns the material stock of subcontractor or not. For example, if the subcontractor owns the material, subcontracting costs included both material and labor costs. In addition, complex components demand assembling already in subcontracting. However, these components are only reported as material costs. This can bias the analysis of subcontracting, which is only regarded as labor costs. Now, the organization has no ability to divide the subcontracting costs accurately into material and labor costs.

Table 8 Consolidated work costs for products Y, Z and X

	Product Y			Product Z			Product X		
	Labor	Sub-contract	Total	Labor	Sub-contract	Total	La-bor	Subcon-tract	Total
Gate 2	80%		80%	106%	18%	124%	119%	20%	139%
Gate 4	72%	28%	100%	100%		100%	16%	84%	100%
Actual	196%	14%	210%	119%	23%	142%	12%	75%	87%
Actual with options	225%	15%	240%	157%	23%	180%	15%	94%	109%

According to NPD development engineer, the labor hour estimates are based on the use of the new product. A lot depends on does the product represent new offering or is it developed based on the older product in the market. The estimates for labor hours are based on the reservation rows of materials. Usually, the new product is compared against division X's older product in the market. NPD development engineer states that they have data of actual labor hours, which are applied to the new product. Data contains assembly time for every material row. According to NPD development engineer, the estimate is rough as material row can be for example the set of pipes or single steel structure. As earlier stated, the objective of cost calculation is to support pricing of the product.

Therefore, the goal is to coordinate. Estimates should be best-guess or even conservative. The actual labor hours include approximately 30 percent waste, which is occurring from the process itself. The waste is for example waiting and distraction in the process according to NPD development engineer. The objective of the estimate is not to provide the optimal labor hours for assembly lines. It is worth of mentioning that labor hours are estimated without options. However, in practice no products without options are manufactured. Until gate three the estimates are rough based on the older product. NPD development engineer states that the most important factor for accurate labor hour estimates is controlled ramp up, where first products are manufactured. The labor hours of the first products are higher than estimates as there are more distractions, and the learning takes more time. According to NPD development engineer there is a lot of potential for improving the estimates, especially before gate three and the ramp up.

According to supply chain development specialist, the actual labor hours are defined by the hours recorded to the job number. Assemblers are directed to one job number, and they report the work hours to that. Assemblers' work hours are reported to the same job number until they are directed to another job. There are situations where for example assembler are waiting component to arrive from supplier. The waiting time is also reported to the job number and therefore as labor costs of product. Supply chain development specialist also states that the line between waiting and assembling is very thin. Even though the assemblers are waiting for component, they can do another following task to the product, even though it is not the fastest way of working. Furthermore, the assembly order is not optimal and therefore the flow of the production is slower. With same resources, less can be done. However, the work continues even though the component has not arrived. Supply chain development specialist also states that there is often lack of components in the entire production, but the assembling continues, only making the total production flow slower.

According to supply chain development specialist, the assembly is the place where the problems of earlier processes will realize. There are requirements, which define the performance of the assembly process. For example, availability of components, quality of components, resources, facilities and instructions are requirements for assembly process to achieve the goals. The decisions in new product development have long-term impacts on the assembling in the future. During the new product development project, the major

part of the assembly costs is decided, long time before the product is in manufacturing. The manufacturing costs for one unit of product are depending for example, on the number of components, difficulty of assembly process and complexity of the product. In addition, supply chain development specialist states that the number of components correlates strongly to manufacturing costs as every component must supply, store and assemble. The higher number of components increases the complexity of the product, which requires high level of quality in assembly process and high-quality materials to achieve the goals. Furthermore, the supply chain development specialist states that in recent history the goal is to launch product quickly to market when the targeted level of manufacturing costs and gross profit of the product are not achieved. In addition, NPD development engineer states that controlled ramp up has been neglected due to the hurry to launch the product to the market. Supply chain development specialist mentions that scientific method, Design for six Sigma, can be used to change targets and requirements to the control parameters. Design for six sigma represents quality management thinking.

Supply chain development specialist states that waiting hours could be reported to the overhead costs, but it would not change the situation as the overhead costs are anyway allocated back to the products. The overhead costs change based on the volumes. When hundred products are manufactured, the costs are lower than when manufacturing eighty products with the same resources. Furthermore, the waiting hours are reported to the product as during the waiting, another task is done as earlier mentioned. Overhead costs are not allocated directly to the product manufactured. According to site controller, overhead costs are allocated based on the forecasted volume and forecasted work hours for the product. If one unit of product is manufactured quicker than products in general in the same period of time, the overhead costs are still allocated to the unit in the same way as to the other similar products. The forecasted work hours are not average work hours for product as then the half of the products would not be manufactured on time. In addition, working hours include options. According to site controller, the forecasted work hours are checked once a year. In the cost calculation forecast for new products, the overhead costs are calculated differently than actual overhead costs. In the forecasted cost calculation, overhead costs are estimated only based on the labor hours in own manufacturing, excluding subcontractor's working hours. For example, product X is mainly subcontracted (table 8), therefore in the cost forecast overhead cost estimate is lower than the actual cost. Therefore, there is deviation of three percentage points in total forecasted

manufacturing costs and actual manufacturing costs in figure 3. Actual overhead costs are allocated all similar products, for example product Z, despite is the product manufactured in the own factory or is it subcontracted. Otherwise the own manufactured products would carry more costs than subcontracted products.

4.3.3 Options

The performance of the product is evaluated using the product's gross profit. In the gross profit calculation options are not divided into their own group. Furthermore, options are not separated from the material or labor costs. This makes the evaluation of options hard as the actual cost cannot be seen. The difference between different unit of products can be caused by options but it can also be caused by the rework, as supply chain development specialist states. For forecasting new product costs, evaluating options is important as options are part of cash flow forecast calculation. It should be mentioned that assumably options increase the gross profit of the product. In the bigger picture, the more complex the product or option is, more costs occur. These are hidden costs if they cannot be separated from the total cost of the product.

In the analysis of this thesis, the standard cost of options is used, which means that the analysis is based on assumptions. If the option needs rework for example, the labor costs and possibly material costs increase, which increases the total manufacturing costs. If more costs are caused by specific option, offering development process should be aware of that. Therefore, options are causing deviations which cannot be observed and analyzed based on the information about costs. Average option package was estimated in every product to be lower than the actual option package was. For product X, average option package was estimated to be lower than the lowest option package in 2020. The same trend continues with products Z and Y. Only one product Y unit had lower costs. With product Z, the estimate of high options was in line with some of the lowest options. Options are approximately 20 percent of total costs of the product, when analyzing products Y, Z and X. Options should only increase the profit margin for product as their profit margin is better than for basic product. Naturally, the pricing also has impact on the product's gross profit. According to product manager A, some market areas want to set the

price of basic unit lower and the price of options higher. Furthermore, this can cause deviations to the price analysis.

Option costs are estimated in the system, where customer orders are made. Every option input to the system must be done manually one by one. This exposes the reporting to errors. Product managers update the option costs based on the input of finance and supply support functions. This has not been done recently as there is long list of options, therefore setting the costs for every option requires a lot of work and resources. In addition, defining options is not easy as some options are done in the beginning of assembly. This provokes issues in determining the costs for product. In addition, the analysis is based on option data, which has not updated since the launch of the product. Analyzing product costs now is very problematic for product managers and finance function.

5 DISCUSSION AND CONCLUSIONS

The objective of this thesis was to investigate, how to develop measures for offering development process in the case organization. Especially interesting is the context, where organizational structure has been modified from vertical to horizontal and process thinking has been emphasized only relatively short time. The results of this thesis suggest that measurement challenges have raised from cross-functionality in the offering development process. As Jeston (2018, 11-12) states, business process management is not a new innovation as it has been developed since early 1900's and have gained more attention from 1980's. Already Langfield-Smith (2005, 73) stated that more research is needed about management accounting and operational strategies, such as quality management and continuous improvements. According to Rashid and Hossain (2020), the same topic still needs more investigating. The purpose of the thesis was to fill the gap in research field.

The theoretical background of this thesis is designed to support the empirical part of the study. In this thesis the management accounting role in different processes is emphasized. The theoretical background involves studies in the field on management accounting, management and operational management building the whole picture of the research issues. Performance measurement is not coherent field of study, therefore different frameworks and studies have been covered. In addition, the practical conclusions about management accounting tools are emphasized in this thesis.

The research data for this thesis are division X's cash flow forecast and cost forecast calculation of the new product development. The documents are gathered during the NPD projects. The document analysis gives information, how the new product has been assessed during the project. Researcher gained the needed understanding about the process, reporting and possible root causes by analyzing the documents. The research data for the thesis was also gathered by interviews. The benefits of the interviews are flexibility, as researcher can ask specifying questions, clarify what is meant and have a conversation with interviewees (Tuomi and Sarajärvi 2018, 63). In this thesis unstructured interviews were used to gather the data. The benefits for unstructured interview in this thesis was that researcher could ask questions based on the interviewees' answers. Structured

interview would not suit for this thesis as interpretations about the topic were different between the researcher and interviewees. In addition, it was crucial for the thesis to understand the interpretations behind the performance measurement and how the estimating had been done. In this thesis interviewees were key persons in offering development process, new product development process, reporting and documentation of the new products.

According to Taipaleenmäki (2014), academics have reached agreement about new product development (NPD) being important for the success of the organizations. In the case division X, the process owner identifies new product development one of the most crucial process in the entire offering development process. Already in 1990's Nixon (1998) states that R&D faces pressure of quick results with high efficiency. In the case division X, the process owner, NPD development engineer and supply chain development specialist all state that recently the emphasis has been in quick results and not in gross profit of the product. In addition, Nixon (1998) argues that R&D usually involve cross-functional activities. Therefore, the performance is hard to measure as stated by Nixon (1998) and Rummler and Brache (2013, 4.) In the case division X, the process owner states that the NPD process crosses the newly structured streams.

Taipaleenmäki's (2014) study implies that management accounting tools are not used for measuring performance in the case companies. However, in the case division X, the project is followed by using cost calculations regularly during the project. In the post evaluation stage, the forecasted performance has been compared against actual performance of the product. The issue has been the deviations, where the root-cause is not easily identified. Taipaleenmäki (2014) suggests more studies about combining control with innovation. In division X, increased reporting and following up the product have positive impact on product's and therefore for process' performance as the deviations are smaller. In addition, empowering employees to improve the process with measures is especially important when we are discussing about professional employees. (Merchant & Van der Stede 2017, 35.) The division X's objective is employee empowerment through targets and accountability of the measures.

Malmi & Brown (2008) emphasize the definition of management control system in their article as there is wide range of definitions by academics. Management control is used for

the control's impact on employee behavior. If the control is only helping with decision-making, it's not management control. Instead, it is information from management accounting system. Process measures can be defined as management control as employees change their behavior to achieve the desired goals. In the division X, NPD measures have impact on employee behavior if the targets are set correctly. For example, as product manager state, the cash flow forecast is used for project management purposes. Employees are directing their actions based on the measures. If the measures would also have motivation-to-achieve dimension instead of only coordination dimension, employees would work to achieve to goals. If employees are using the measures only for decision-purposes, the measures are not called management control system.

As Chenhall (2003) states that management controls systems are not working in isolation from each other and therefore cannot be separated from the context. According to Malmi and Brown (2008) academics have studied different innovations, such as balanced scorecard, in different contexts. Furthermore, the studies would be more accurate if the package of management control systems is emphasized instead of only the design, implementation and use of innovation. In the division X, the process and quality thinking are emphasized in the communication from management to employees. Therefore, the division X is using cultural controls. In addition, the organization structure has recently been changed from functional to emphasizing processes by streams. Malmi and Brown (2008) define the organization structure as an administrative control. Division X also uses result controls in organizational level, which means that organizational targets are communicated through strategy. The process measures add extra dimension for performance measurement in division X. According to Malmi and Brown (2008), performance measures can be defined as cybernetic controls as they focus on deviations between the target and actual performance. The objective of the study is to help for developing measures for one core process based on the process management, which is management philosophy and innovation.

According to De Feo and Juran (2014), quality can be managed by planning, controlling, and continuously improving the quality. These three processes are based on financial processes and are crucial for improving process performance. Organization learns by measuring and reviewing the performance regularly. As De Feo and Juran (2014) state, business process management is not done once but continuously. In the division X, there are already good documentations about process, and consolidation about lessons learned in

new product development project. As former project manager states, the post evaluation phase of the products could be developed to learn about the products after launching them. In addition, the information should flow in entire process, which also includes assembling, supplying, and selling the product. Old functional boundaries should be forgotten to improve the entire process.

Organizations must identify the key processes, when managing the business processes. (De Feo & Juran 2014.) Division X has identified four core processes, which produce most value to the customer. These core processes have process owners who are accountable of the process and its performance. The ownership of the process and accountability for the performance decrease the cross-functional issues, which are not visible or at least hard to observe. Processes can also have two owners – in practice, the other is responsible for the results and other is accountable for daily operations. (De Feo & Juran 2014.) In division X, there is process owner for the entire offering development process. Furthermore, the product managers have increasing accountability for the gross profit of their products. The ownership of measures makes the old cross-functional issues easier to observe.

According to Merchant and Van der Stede (2017, 34), results controls are important for highlighting employee empowerment, which is important for process management. Tools for employee empowerment are for example ownership and accountability of processes in business process management (De Feo & Juran 2014). Merchant and Van der Stede (2017, 42) state that organization must determine desired results and communicate them effectively. Measures should be always aligned with organization's strategy (e.g. Merchant & Van der Stede 2017, 42; De Feo & Juran, 2014; Kaplan & Norton 1996; Rummier & Brache 2013, 191). In the division X, in offering development process, the evaluated measures are based on organization's strategy as they present gross profits of the products. By improving them, the gross profit of the organization improves according to strategy. Merchant and Van der Stede (2017, 39) state that different organizational levels use different goals, therefore financial goals should be translated to operational goals. In offering development process, the gross profit of products is financial measure. The sub-processes should have their own goals to improve the core process measure, which are either financial or operational, for example labor hours. The sub-processes of processes

should also have their own goals. This requires effective communication through the organization.

Results controls have cybernetic nature, as the deviations can be investigated, and the root causes found. (Merchant & Van der Stede 2017, 38.) In addition, De Feo and Juran (2014) argue that the desired results cannot be achieved if the causes for issues cannot be identified. Therefore, the measurement data should help to identify the error. In division X, the causes for issues are not visible by analyzing the measurement data currently. It is not possible to separate causes for deviations from the current actual data. For example, in the division X, the option costs cannot be separated from material and labor costs in current cost measurement data. Currently the measures include measurement issues, which means that controls cannot be measured effectively.

According to Merchant & Van de Stede (2017, 43), good measures are precise, objective, easy to understand, on time and cost-efficient. Without the good qualities of measures, it is hard to evaluate, have the good actions and decisions taken. (Merchant & Van der Stede 2017, 228.) Usually the measures contain error, which can be either systematic or random. In NPD calculations there are systematic errors related to the assumptions behind the calculations. Overhead cost forecast calculation is based on different assumption on how the overheads are allocated than the actual overhead calculation. The measures can be used with systematic error if they are precise enough. Furthermore, the systematic error, which can also be called noise, should be identified to use measures efficiently and for desired results. In this case, it is possible to decrease systematic error by recalculating the overhead costs in forecasts. In addition, the calculations contain random error, which is caused by the material costs. In the ERP system all material costs are not correct, which has impact on preciseness of measures. This requires actions, which are already ongoing to achieve the targets.

The measures should be understandable for the persons, who are held accountable for the measures (Merchant & Van der Stede 2017, 44). This means that calculations should be understood by everyone in the NPD project. Product managers are held accountable for the profitability of their products. Therefore, they should be able to understand, how the gross profit of the product is formed. Product managers consolidate the estimates but do not calculate the biggest shares of the manufacturing costs, which are material and labor

costs. If the product manager is held accountable for the product profitability, they should be more aware how material and labor costs are calculated. In the process view, it should also be understood, how for example rework or component delays have impact on product costs already in developing the new process. For example, rework increases both material and labor costs. The causes for rework can be for example poor quality component or complexity of assembly. These should be considered during the NPD project, the post evaluation stage and furthermore, after the post evaluation of the product. These hidden costs should be considered when developing current offering and initially when developing new products.

The measures for evaluating offering development process should be timeliness (Merchant & Van der Stede 2017, 44). The performance of the products is evaluated after the product is launched, when the real costs occur, and the customers pay the actual price. The history cannot be controlled; therefore the process is measured during the new product development. The lessons learned from earlier projects can improve the performance continuously. When the measures are more accurate and precise, they can be reliably assessed during the project. The NPD process and the project already use gate model, where the performance is evaluated during the project. The goal for forecasting the cash flow for products is to forecast as accurately as possible. Therefore, the deviations between different gates should be low. The process and measurement data in the future should provide feedback on time. Then, the complex assembly steps and poor-quality components could be identified on time. This enables changes already during the development project of new product.

According to Merchant & Van der Stede (2017, 45), measures with highest net benefits should be implemented to the organization. This means that benefits should be higher than the costs of the measures. The cash flow forecast, and cost calculation are cost-efficient measures as they are done in any case. Now the objective of cash flow forecast, and the cost calculation is to coordinate the pricing of the product. When the measure's target is coordination or planning, the estimate should be best-guess or even conservative value. The cash flow forecast, and cost calculation can also be used for motivation-to-achieve by setting the targets to optimal level. The sub-processes of forecasting cash flow, which are material cost forecasting and labor cost forecasting could have their own motivation-to-achieve goals. These calculations could be then used cost-efficiently for other purposes

than pricing and project management. In addition, the target should be clear for every sub-process and entire process. Choosing the right measures is important as employees try to improve the measures whether or not they lead to positive results (Merchant & Van der Stede 2017, 38). In the division X, process owners work closely with developing the measures as they know the process and are accountable for its performance.

Rummler and Brache (2013, 187) present their own framework, where measures are divided into three different groups M1, M2 and M3. M1 measures the end-to-end process, M2 is linked to M1 and measures sub-processes, and M3 measure processes phases, which are critical for the overall performance of the process. In division X, in offering development process, the M1 measure can be the gross profit of the products, even though other core processes have impact on gross profit. M2 measures the sub-processes, which are the different components of product's gross profit. For example, estimating labor and material costs can be measures for sub-processes. With M3 the accuracy of actual data can be measured in order to improve the measures for identifying root causes. In their framework Rummler and Brache (2013, 194) emphasize how every process should be managed and measured. It's crucial for processes to have process owners. In division X, the core process has process owner, who is accountable for the entire process. In the future, sub-processes should also someone accountable for the measures to manage the entire process. Rummler and Brache (2013, 200) also state, how the organization should have network of measures, which are related to each other. For example, in the division X, we have analyzed the gross profit in the offering development process. The analysis goes further as we can identify variables, such as material and labor cost. This goes further as we can analyze, how the labor cost is calculated. Finally, the root-causes can be identified if the measures are connected.

De Feo and Juran (2014) state that in business process management, process owner is responsible for the performance, which consists of effectiveness, efficiency, and adaptability. The process is effective, when the output satisfies customer and process is efficient, when the customer is satisfied with lowest cost. The adaptability of the process is achieved when process maintains effective and efficient when changes occur. They also emphasize continuous measurement and therefore, continuous improvement. De Feo and Juran (2014) state that the whole organization performs well, when the core processes are performing well. Kaplan's and Norton's (1996) balanced scorecard have similar

principles, but they are only divided into different dimensions. Financial perspective represents the total performance of the organization, customer dimension indicates about customer satisfaction, internal process view about efficiency, and learning and growth about employee satisfaction. If the emphasis is on right measures, any framework can work. In this thesis balanced scorecard framework is utilized to present the development suggestions for the process measurement.

The financial dimension can be measured using the gross profit, which can be divided into components, such as material cost, labor cost and overhead costs. The goal is to improve data accuracy. Forecasted overhead costs are calculated based on different assumptions than the actual overheads. This should be emphasized in the future. Furthermore, the actual data is not precise and accurate enough to identify root causes for deviations. This can be seen in material costs as the data in ERP-system is not accurate and precise in some cases. In addition, option costs can cause large deviations, but for now they cannot be separated. Furthermore, the higher costs in the unit of product can be rework costs or due to waiting of component instead of only including option costs. For improving the products in offering development process, the root causes for higher costs should be identified and analyzed continuously.

In the cash flow forecast, volume for the product is estimated as number of products sold. The figure does not take the market growth or common economic situation into account. Based on the process owner, when assessing the customer satisfaction, the market share would give more information about the performance. It's also important to analyze the deviations between the forecasted and actual to learn about the deviations.

The third dimension in Kaplan's and Norton's (1996) balanced scorecard is internal business processes. While managing business processes, the emphasis is on measuring process performance. In this dimension, the root causes behind the deviations should be identified. For example, why the labor costs of product Y are higher than estimated. Is the reason in the options, which cannot be separated from the cost, is the assembly of the product complex or does delays in some components increase the amount of labor hours? The assessing of the product should be done during the post evaluation phase, but also after it continuously. As product manager A states, one or two years do not always provide enough data for intensive analysis of the product.

The learning and growth perspective presents employee satisfaction, which can be employee empowerment and continuous learning through continuous improvements. This can be measured subjectively by documenting lessons learned and possibly quantifying the lessons learned. Also, quality questionnaires are already used for measuring performance, and core processes can utilize the measures better in the future. Measures increase motivation of employees (Merchant & Van der Stede 2017, 38). If employees can achieve goals, learn about processes and improve the processes, they feel empowered.

Neely (2005) and Taticchi et al. (2012) state that organizations should move from measuring the performance to performance management. As the changes occur in organizational environment, measurement should be flexible (Neely 2005). In addition, Taticchi et al. (2012) argue that assessment of measures is important for continuous improvements. As Neely (2005) states, measures themselves do not improve the performance, they are tool for managing it. In division X, it is important that measures are evaluated from time to time. New product development project is a long process, where the actual performance can be assessed not until the product is on the market. Even though history cannot be controlled, the offering development process can learn from it. In addition, assessing the assumptions behind the measurement data is important to compare same things in the future. At least knowledge about the assumptions behind the calculations can be increased. According to Merchant and Van der Stede (2017, 43), measures should be congruent with the desired performance. Therefore, the measures should be congruent with other management control systems. Furthermore, Rummler and Brache (2013, 194) argue that in every level of organization, meaning organization, process and employee, the measures should not conflict with each other. Instead, they should be linked and based on the strategy. If division X is launching management control system, the future process measures should be in line with the strategy. In addition, the old functional borders should be forgotten. The organization works for the same goal, therefore improving gross profit is the goal for everyone in the organization. For example, offering development process can advance the cooperation with the supply chain process to improve the process in future. Understanding, how the decisions in development phase impact the product profitability for example, in manufacturing process, is crucial for continuous improvements in offering development process. Therefore, supply chain process should be capable to produce data about root causes, which demands the support from business control and supply

in the future. The discussion should focus on how the root causes for significant costs can be identified, act based on root causes and continuously improve the processes in different levels of organization. For example, how to allocate the waste in manufacturing process to find root causes and improve the entire process, is worth of discussion. The communication is the key.

This thesis objective was to provide solutions in the practical level to the case organization. When evaluating and developing the measures for business processes, there are three matters that case organization should consider. First, improving the qualities of measures is important as measurement issues were identified in the NPD calculations. Furthermore, these NPD measures should be improved before developing the measures further to indicate about the total performance of the offering development process. Secondly, the process consistency is important for improving the performance of offering development. The cross-functional issues can still be seen in the calculations. Every stakeholder of the process should have the same assumptions and methodology behind the calculations in order to produce accurate information, which supports the total performance. The measures and calculations for forecasting should be in line with actual numbers. At least, the documentation can be improved to compare the same things in the future. For example, the forecasting of overheads should be based on the same assumptions than actual overhead costs. In addition, identifying and understanding the significant costs occurring in different phases of the process is crucial for the total performance of the process. Finally, developing the information systems is important for case organization to produce data and therefore measurements for improving the offering development process. In this current situation, all data needed for identifying root-causes for undesired performance, is not available. In addition, this thesis gives practical advices to organizations, which are developing process measures while emphasizing business process management and structuring their organization from functional to horizontal. For the field of management accounting, the thesis emphasizes the role of business control in the developing process measures. Management accounting tools were used to identify deviations between the measures. The role of management accounting is to assure that the data is accurate in measures to prevent measurement issues. These issues can lead to undesired results and uncertainty about the actions taken (Merchant & Van der Stede 2017, 228).

In case studies, the context is hard to separate from the researched phenomenon (Llewellyn & Northcott 2007). Therefore, the results of this case study cannot be generalized and transferred to another context. As Malmi and Brown (2008) state, every organization is different, and they have different management control system packages. Therefore, this topic is organization specific. Furthermore, the results of this study reflect the subjective interpretations of interviewees in one case organization. For example, the industry of the organization and the backgrounds of interviewees have impact on results.

Despite the lack of generalizations, the results of this thesis provide topics for future research. In the case organization, the other core processes could be investigated, and new measures developed to improve the performance of the entire business process and to create network of measures in the case organization. In addition, the future research in management accounting could focus on the business process measures, which are used and evaluated for a longer period of time using longitudinal study. Furthermore, the survey research about management accounting's role with developing performance measures in organizations emphasizing quality and process would provide results for generalizations in the future.

REFERENCES

- Alvesson, M., & Kärreman, D. (2004). Interfaces of control. technocratic and socio-ideological control in a global management consultancy firm. *Accounting, Organizations and Society*, 29(3), 423–444. doi:10.1016/S0361-3682(03)00034-5
- Bhimani, A., Horngren, C. T., Datar, S. M., & Rajan, M. V. (2019). *Management and cost accounting*. Harlow, England: Pearson.
- Chenhall, R. H. (2003). Management control systems design within its organizational context: Findings from contingency-based research and directions for the future. *Accounting, Organizations and Society*, 28(2), 127–168. doi:10.1016/S0361-3682(01)00027-7
- Davenport, T.H & Short, J. E. (1990). The New Industrial Engineering: Information Technology and Business Process Redesign. *Sloan Management Review*. 31(4), 11–27.
- De Feo, J.,A., & Juran, J. M. (2014). *Juran's quality essentials: For leaders*. New York: McGraw-Hill Education LLC.
- DeToro, I. & McCabe, T. (1997), "How to stay flexible and elude fads", *Quality Progress*, 30(3), 55–60.
- Endrikat, J., Guenther, T. W., & Titus, R. (2020). Consequences of strategic performance measurement systems: A meta-analytic review. *Journal of Management Accounting Research*, 32(1), 103–136. doi:10.2308/jmar-52575
- Flamholtz, E. G., Das, T. K., & Tsui, A. S. (1985). Toward an integrative framework of organizational control. *Accounting, Organizations and Society*, 10(1), 35–50. doi:10.1016/0361-3682(85)90030-3
- Franco-Santos, M., & Bourne, M. (2005). An examination of the literature relating to issues affecting how companies manage through measures. *Production Planning & Control*, 16(2), 114–124.
- Hammer, M. (1990). Reengineering work: don't automate, obliterate. *Harvard business review*, 68(4), 104–112.
- Hoque, Z. (2014). 20 years of studies on the balanced scorecard: Trends, accomplishments, gaps and opportunities for future research. *British Accounting Review*, 46(1), 33–59. doi:10.1016/j.bar.2013.10.003
- Hung, R. (2006). Business process management as competitive advantage: A review and empirical study. *Total Quality Management & Business Excellence*, 17(1), 21–40. doi:10.1080/14783360500249836
- Jeston, J. (2018). *Business process management: practical guidelines to successful implementations*. London: Routledge.
- Kaplan, R. S., & Norton, D. P. (1996). Using the balanced scorecard as a strategic management system. *Harvard Business Review*, 74(1), 75–85.
- Kaplan, R. S., & Norton, D. P. (2008). Mastering the management system. *Harvard Business Review*, 86(1), 62–77.
- Kaplan, S. E., & Wisner, P. S. (2009). The judgmental effects of management communications and a fifth balanced scorecard category on performance evaluation. *Behavioral Research in Accounting*, 21(2), 37–56.
- Kaynak, H. (2003). The relationship between total quality management practices and their effects on firm performance. *Journal of Operations Management*, 21(4), 405–435. doi:10.1016/S0272-6963(03)00004-4

- Langfield-Smith, K. (2007) What do we know about management control systems and strategy? In Chapman, C.S. (Ed.) *Controlling Strategy: Management, Accounting and Performance Measurement*. Oxford University Press, 62–85.
- Lee, B. & Humphrey, C. (2017) Case studies in accounting research. In Hoque, Z. (Ed.) *The Routledge companion to qualitative accounting research methods*. London: Routledge, 163–183.
- Lee, R. G., & Dale, B. G. (1998). Business process management: A review and evaluation. *Business Process Management Journal*, 4(3), 214. doi: 10.1108/14637159810224322
- Llewellyn, S., & Northcott, D. (2007). The "singular view" in management case studies. *Qualitative Research in Organizations and Management*, 2(3), 194. doi:10.1108/17465640710835355
- Malmi, T. (2001). Balanced scorecards in finnish companies: A research note. *Management Accounting Research*, 12(2), 207–220. doi: 10.1006/mare.2000.0154
- Malmi, T., & Brown, D. A. (2008). Management control systems as a package—Opportunities, challenges and research directions. *Management Accounting Research*, 19(4), 287–300. doi:10.1016/j.mar.2008.09.003
- Merchant, K., & Stede, W. V. d. (2017). *Management control systems*. Pearson Prentice Hall.
- Neely, A. (2005). The evolution of performance measurement research: Developments in the last decade and a research agenda for the next. *International Journal of Operations and Production Management*, 25(12), 1264–1277. doi:10.1108/01443570510633648
- Neely, A., Mills, J., Platts, K., Richards, H., Gregory, M., Bourne, M., et al. (2000). Performance measurement system design: Developing and testing a process-based approach. *International Journal of Operations & Production Management*, 20(10), 1119–1145. doi:10.1108/01443570010343708
- Nixon, B. (1998). Research and development performance measurement: A case study. *Management Accounting Research*, 9(3), 329–355. doi:10.1006/mare.1998.0079
- Orbis (2021). Company information. Referenced: 2.5.2021. <http://www.orbis.bvdinfo.com.libproxy.tuni.fi>
- Powell, T. C. (1995). Total quality management as competitive advantage: A review and empirical study. *Strategic Management Journal*, 16(1), 15–37. doi:10.1002/smj.4250160105
- Rashid, M.M., Ali, M.M. & Hossain, D. M. (2020) Revisiting the relevance of strategic management accounting research. *PSU Research Review*, 4(2), 129–148.
- Rummler, G. A., & Brache, A. P. (2013). *Improving performance how to manage the white space on the organization chart*. San Francisco: Jossey-Bass.
- Salminen, A. (2011). Mikä kirjallisuuskatsaus? Johdatus kirjallisuuskatsauksen tyyppeihin ja hallintotieteellisiin sovelluksiin. In Opetusjulkaisuja 62: julkisjohtaminen 4. Vaasa: Vaasan yliopiston julkaisuja, 1–44.
- Taipaleenmäki, J. (2014). Absence and variant modes of presence of management accounting in new product development – theoretical refinement and some empirical evidence. *European Accounting Review*, 23(2), 291–334. doi:10.1080/09638180.2013.811065
- Taticchi, P., Balachandran, K., & Tonelli, F. (2012). Performance measurement and management systems: State of the art, guidelines for design and challenges. *Measuring Business Excellence*, 16(2), 41–54. doi:10.1108/13683041211230311
- Tuomi, J., & Sarajarvi, A. (2018). *Laadullinen tutkimus ja sisällönanalyysi*. Helsinki: Tammi.

Zairi, M. (1997), "Business process management: a boundaryless approach to modern competitiveness", *Business Process Management*, 3(1), 64–80

APPENDIX

APPENDIX 1: Interview guide

Interview	Interview guide
First interview with vice president of R&D	<ol style="list-style-type: none"> 1. Offering development process <ul style="list-style-type: none"> - Is the current process the same as demonstrated earlier in documents? - If different, how? 2. The measurement of offering development <ul style="list-style-type: none"> - Has the process been measured earlier? - If yes, how? 3. Challenges in the process <ul style="list-style-type: none"> - How you see the current challenges in the process? - How you see current challenges if you reflect the organization's strategy? 4. The performance of the process <ul style="list-style-type: none"> - What are the most important stages in the process regarding the performance? - What are the most important factors in the process regarding the performance? 5. The future of the measurement <ul style="list-style-type: none"> - How you see the offering development process measurement in the future?
Interview with former project manager	<ol style="list-style-type: none"> 1. The context of offering development and NPD processes 2. How the gate model is working in the division? 3. Process performance <ul style="list-style-type: none"> - What are important stages in the process regarding the performance? 4. Challenges of the process <ul style="list-style-type: none"> - What are the challenges you see in the process?
Second interview with vice president of R&D	<ol style="list-style-type: none"> 1. The choices for the analysis of NPD project <ul style="list-style-type: none"> - Which product are analyzed? - What are the most important documents for evaluation of performance? - What stages of gate model are analyzed? 2. Forecasting in NPD process 3. Post evaluation of the product
Interviews with product managers	<ol style="list-style-type: none"> 1. NPD measures <ul style="list-style-type: none"> - How the measures are calculated? - From where/who the information is gathered? - Is the data modified for calculations? - What is the impact of options to calculations? 2. The development of calculations <ul style="list-style-type: none"> - Have the calculations been developed after the analyzed projects? 3. The role of product managers in post evaluation stage 4. The challenges in the process 5. Measurement in the future

Interview with site business controller	<ol style="list-style-type: none"> 1. Actual costs and the actual calculations <ul style="list-style-type: none"> - What was the real labor rate in 2020? - From which system the actual labor cost data is from? How is it collected? - What principles are used to define actual labor costs? - What principles are used to define actual overhead costs?
Email interview with supply chain development specialist	<ol style="list-style-type: none"> 1. The actual labor costs <ul style="list-style-type: none"> - What principles are used to report actual labor costs for the products?
Email interview with NPD development engineer	<ol style="list-style-type: none"> 1. The estimated labor costs for new products <ul style="list-style-type: none"> - What principles are used to define estimated labor costs for the products during the NPD project?
Third interview with vice president of R&D	<ol style="list-style-type: none"> 1. The development of measures <ul style="list-style-type: none"> - How you see the measures in the future based on the analysis of the products?